INDEXED.

Marine Engineering

APRIL, 1906

FRENCH ARMORED CRUISERS.

BY J. PELTIER.

Since 1898 there have been completed for the French navy thirteen armored cruisers, which may be divided into five types: Three units of 7,700 tons; three of 9,500 tons; five of 10,000 tons; one of 11,300 tons; and one of 12,500 tons. In addition to these, there are under construction three additional cruisers of 12,500 tons and three of 13,600 tons. The particulars of these six types of cruisers will be found given in the table, which covers all of the leading items of information with regard to dimensions, power, speed, battery, protection and steaming radius.

The *Leon Gambetta*, which is the first of the 12,500-ton cruisers to be placed in service, made a trial speed of 23.1 knots as an average for three hours, during which time the indicated horsepower averaged 29,008, with a maximum of 30,500. The Admiralty coefficient at this speed figures out as 230. A twenty-four-hour trial at three-fourths the full power resulted in 16,990 indicated horsepower and a speed of 20.4 knots, which corresponds with an Admiralty coefficient of 271. A twenty-four-hour coal consumption trial gave a speed of 20.1 knots with 16,600 horsepower and an Admiralty coefficient of 265. In this trial the coal consumption per indicated horsepower per hour figured out at 0.772 kilogram, or 1.7 pounds.

THE FRENCH ARMORED CRUISER LEON GAMBETTA, OF 12,600 TONS.

This ship has two protective decks, the lower one of which reaches 4 feet 7 inches below the mean load waterline, and is connected with the lower edge of the armor belt. The upper protective deck is 7 feet 6 inches above the waterline, being at the top of the heavy side armor, which has a width of 12 feet 1 inch and a thickness of 6.7 inches. This thickness is reduced at the lower edge and is also reduced at the ends of the ship, at which points it is only 3.5 inches. The upper part of the armor belt has a thickness of five inches amidships and 2 inches at the ends. The belt is carried across near the stern by a bulkhead situated abaft the rudder post, and the extreme stern is unprotected by side armor. There are two other armor bulkheads on the ship, one of them being just abaft the forward barbette and the other just before the after barbette. These bulkheads have a thickness of 4.8 inches and extend from main deck to spar deck, thus protecting the 'tween decks from a raking fire. The whole of the belt armor is laid on a backing of teak, and water excluding material is packed in a cofferdam behind the armor and backed up by a watertight longitudinal bulkhead. The thickness of the lower armor deck varies from 2.2 inches to 1.8 inches, while the upper armor deck has a thickness varying from 1.3 to 0.8 inches.

The battery of this ship includes four guns of 7.7 inches; sixteen of 6.4 inches in caliber; twenty-two 3-pounder rapid fire guns and five torpedo tubes, of which two are submerged. This is so disposed that the fore-and-aft fire consists in two 7.7-inch guns and six 6.4-inch guns, while there may be concentrated on either broadside four of the former and eight of the latter. The 7.7-inch guns are mounted in pairs in closed barbettes forward and aft, and twelve of the 6.4-inch guns are similarly mounted in pairs in turrets on the spar deck, the other four being in casemates. Of the 3-pounder guns, six are on the upper armored deck, ten on the main deck and six on the bridges.

The protection for the heavy turret guns consists in armor with a thickness of 7.9 and 5.5 inches respectively, while the casemates inclosing four of the 6.4-inch guns have walls of a thickness of 4.7 inches with 1-inch splinter bulkheads, 1-inch

Owner.	France.			France.			England.	
Name.	Desaix, Kleber, Dupleix.	Montcalm, Amiral Gueydon, Dupetit Thouars.	Gloire, Condé, Sully, Amiral Aube, Marseillaise.	Jeanne d'Arc.	Leon Gambetta, Jules Michelet, Jules Ferry, Victor Hugo.	Ernest Renan, Waldeck Rousseau, Edgard Quinet.	Drake.	Natal.
Normal displacement, tons	7,700	9 515	10 014	11,300	12,606	13 644	14.100	13.550
Length at waterline, feet	426′ 6″	452′ 9″	452′ 9″	475′ 9″	487′ 4″	515′ 1″	500′	480′
Extreme breadth	58′ 7″	63′ 7″	66′ 2″	63′ 7″	70′ 2″	70′ 1″	71′	73 6″
Astern draught	24′ 4″	24′ 7″	24′ 9″	26′ 7″	26′ 10″	26′ 10″	26′	27′
Horsepower	17.100	19.600	20,500	28,500	29 000	36 000	31.700	23.500
Speed	21	21	21	21.7	22.5	24	24.3	22.5
Admiralty coefficient	211	212	210	181	213	219	261	275
Armor belt amidships	4″	5.5″	5.5″	5.5″	6.7″	6.7″	6″	5.5″
Armor belt forward, aft	2.2″ 0	2.2″ 2.2″	3″ 2″	2 2″ 2 2″	3.4″ 3.4″	3.4″ 3.4″	2″	4″ 3′
Armor belt, upper strake	....	3.5″	5″	2 8″	5″	5″	4.7″	5.5″
Armor bulkheads	4″	4.5″	4.5″	4.5″	4.5″	4.5″	4.7″ 8″	6″
Armor barbettes	7.5″	7 5″	7.5″	7.5″	7.5″ 5.2″	7.5″ 5.2″	6″	5.5″
Armor turrets and casements	....	4.5″	4.5″	4.5″	4.5″ 4″	4.5″ 4″	5″	4″
Lower protected deck	1.7″ 2″	1 1″ 2″	1.7″ 2″	1.1″ 2″	1.8″ 2 2″	1.8″ 2.2″	2″ 3″	2.5″ 1″
Upper protected deck	1.1″	1.1″	1.2″	1.1″	0 8″ 1.3″	0.8″ 1.3″	....	.....
Conning tower	6″	6″	7.5″	7.5″	7.5″	7.5″	12″	9 5″
Battery	10 6.4″ 4 3.9″ 10 3-pdr. 6 1-pdr.	2 7.7″ 8 6 4″ 4 3 9″ 16 3-pdr. 6 1-pdr.	2 7.7″ 12 6.4″ 4 3.9″ 18 3-pdr. 6 1-pdr.	2 7.7″ 8 5.5″ 10 3 9″ 16 3-pdr.	4 7.7″ 16 6.4″ 22 3-pdr.	4 7 7″ 16 6.4″ 28 3-pdr.	2 9.2″ 16 6″ 14 3″ 3 3-pdr.	6 9.2″ 4 7.5″ 20 3-pdr. .....
Torpedo tubes	....	....	....	....	....	....	....	.....
Coal (nominal—bunker capacity)	2	2 (sub.)	5 (2 sub.)	2 (sub.)	5 (2 sub.)	5 (2 sub.)	2 (sub.)	3 (sub.)
Steaming radius at 10 knots	880–1,200	1 020– 1,920	1.520– 2 000	1,400– 2,100	1,400-2 100	....	1,250–2,580	1,000—(?)
Steaming radius at 21 knots	6,450–8,800	6,500–10 800	6 500–10.300	9 000–13,500	12 000	....	at 19 knots,	.....
Crew	1,210 1,650	1,230– 1,890	1,230– 1,890	1,250– 1,700	1,500 at 22 kn'ts	....	2,150–4,300	.....
	480	562	525	605	700	800	900	804

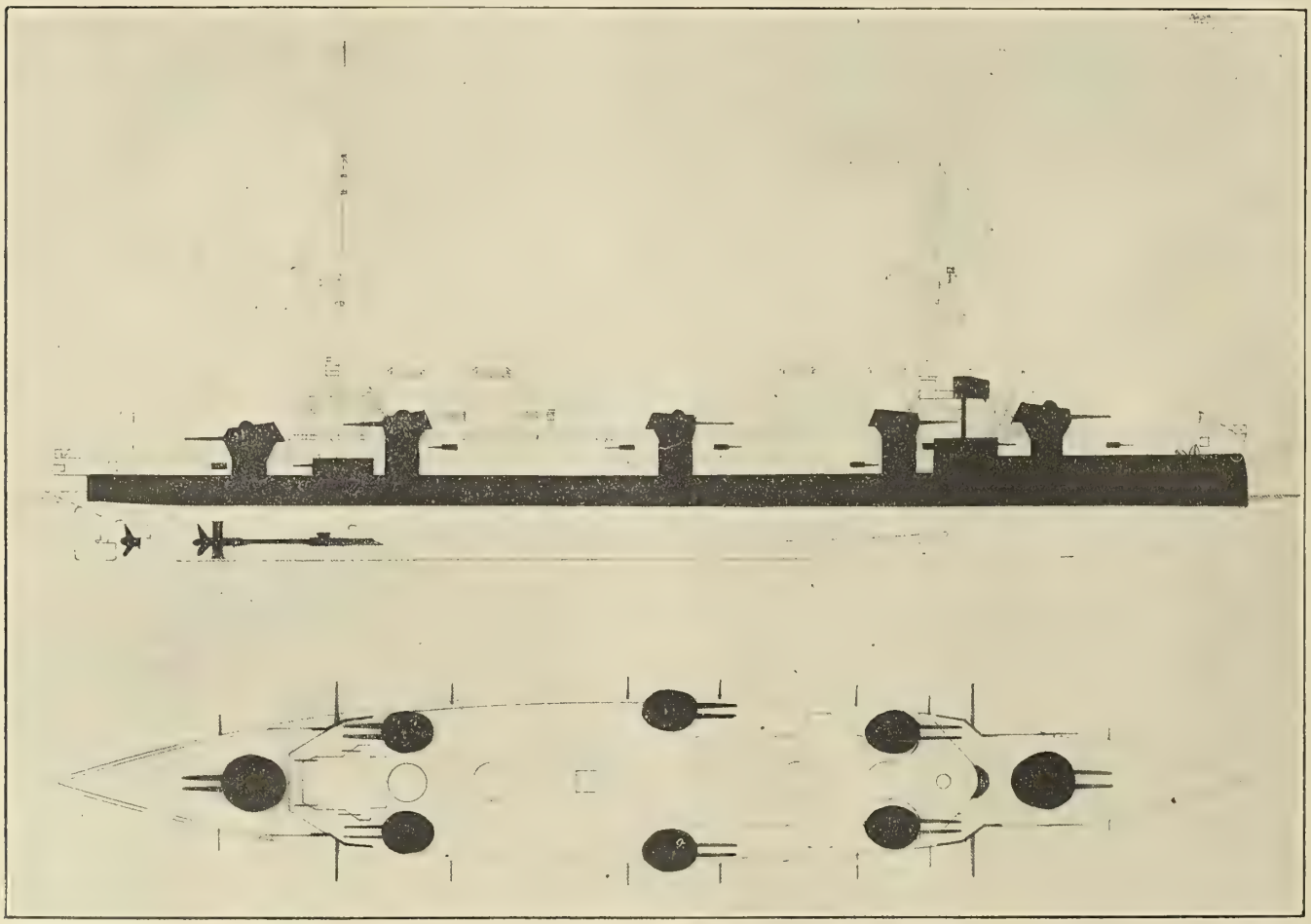


DIAGRAM OF LEON GAMBETTA, SHOWING DISPOSITION OF GUNS AND ARMOR.

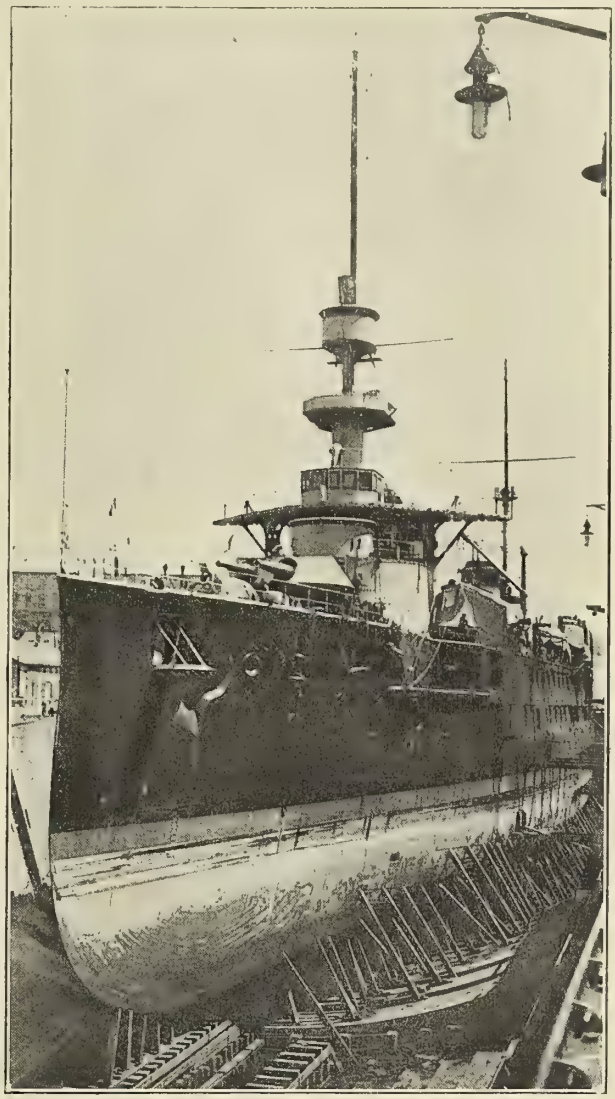
ceiling and 1.2-inch floor plates. These casemates are really continuations of the side armor, which makes it impossible for them to be destroyed by cutting away the underpinning, as is the case in many constructions.

The ship is driven by three screws actuated each by a separate four-cylinder, triple-expansion engine with piston diameters 39-inch, 59-inch and two each of 65-inch, and a common stroke of 37 inches, and operating at 125 revolutions per minute. These engines are located amidships between the sets of boilers. The latter, twenty-eight in number, are of the Niclausse type, with a total grate surface of 970 square feet, and operate at a pressure of 216 pounds per square inch. Each set of fourteen boilers

Germany.	Italy.		United States.	
Friedrich Karl.	Roma.	Amalfi.	California.	Tennessee.
9,050	12 625	9.864	13.680	14 500
413′ 5″	474′ 2″	427′	502″	502″
65′ 7″	73′ 5″	68′ 9″	69′ 6″	72′ 10″
24′ 3″	27′-2″	23′ 6″	24′ 1″	25′
17.000	20.000	18.000	26 800	23 000
21	22	22.5	22.3	22
237	288	287	237	275
4″	10″	7.8″	6″ 5″	5″
3″ 3″	4″ 4″	?	3″ 3″	2.8″ 2.8″
4″	8″	7.1″	4″	4″
4″	7.5″	?	4″	4″
6″	8″	?	6″	7″ 4″
6″ 3″	6″ 3″	?	6.5″ 6″	9″ 7″ 5″
2″ 1.5″	4″ 1.5″	?	4″ 1.5″	4″ 1.5″
....	....	....	....	.....
6″	10″	7.8″	8.5″	8.5″
4 8.2″	2 12″	4 10″	4 8″	4 10″
10 5.9″	12 8″	8 8″	14 6″	16 6″
12 3.4″	12 4″	16 3″	18 3″	22 3″
10 1-pdr.	12 3-pdr.	8 3-pdr.	12 3-pdr.	12 3-pdr.
....	....	....	....	.....
4 (3 sub.)	4 (2 sub.)	3 (1 sub.)	2 (sub.)	4 (sub.)
950-1,500	1,000–2,800	700-1,500	900–2,024	900–2,014
5,000	10,000	....	....	.....
....	....	....	....	.....
624	750	....	790	810

is served by two funnels measuring 65 feet above the grate bars. The maximum speed obtained during the trial runs over the measured mile was 24 knots, which required 30,500 horsepower. Several other individual runs go as high as 23.6 knots. The consumption of fuel is such that with the total bunker capacity of 2,100 tons of coal, the steaming radius at 11 knots figures out at 12,000 nautical miles, and 1,500 miles at 22 knots. In addition to the coal supply, provision is made for carrying 100 tons of liquid fuel. The normal bunker capacity is 1,400 tons.

Ventilation of all compartments below the protective deck is taken care of by means of electric fans, fresh air being drawn in through ducts located between the funnels. Bilge pumps are fitted, with a total hourly capacity of 700 tons of water. Electricity is used to a considerable extent not only for lighting but for certain of the auxiliary machinery, turret turning, ammunition hoists, steering gear and fans. There are six searchlights, two being fitted forward and two aft, and one on each mast.



BOW VIEW OF GAMBETTA IN DRY DOCK.

ARMORED CRUISER GLOIRE, OF 10,014 TONS.

Electricity is generated by means of four dynamos, three being required for constant service, while the fourth is in reserve.

The ammunition hoists carry ammunition for the 7.7-inch guns from magazines directly beneath the barbettes. Other ammunition is stored in rooms between the main engine rooms and the boiler rooms.

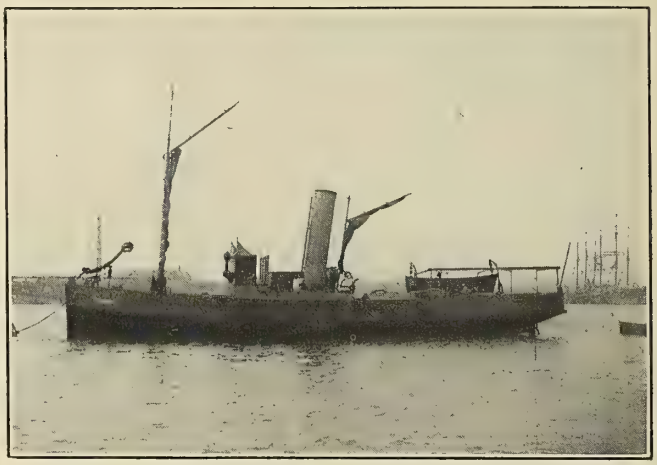
Taking the ship as a whole, she forms an interesting solution of the problem of condensing in a moderate displacement high speed, powerful artillery, good protection and a satisfactory steaming radius. She represents the resultant of improvements indicated by experience with previous types, and has got away from the bad features incident to the early attempt to include much the same military qualities in a vessel of 7,700 tons. In these small ships the engines are fragile, the hull weak and the cost of keeping the ship in good repair overbalances the difference in first cost which would have been required for better and larger constructions.

The *Leon Gambetta* is known as a vanguard cruiser, having all the necessary qualities to search for the enemy and to keep in contact with him; her speed and small artillery insure her against successful attack by destroyers, while her protection and heavy artillery make her able to fight on equal terms against similar cruisers in foreign navies, and momentarily with a battleship. It would be impossible, however, for her to long sustain an engagement with such a powerful antagonist, because of the fact that her superstructure would be destroyed in a very short space of time, and with such effect as probably to nullify all attempts to supply the turrets and guns and keep them in working order. Not only this, but the destruction of the base of the funnels would fill the upper works of the ship with smoke and hydro-carbon gases from the fires, rendering asphyxiation extremely likely. This would also operate to neutralize the effect of forced draft, and thereby cut down the speed.

The second part of the table deals with similar cruisers of about the same sizes in foreign navies. One of these ships, the *Roma,* is usually called a battleship, but her speed is such that she properly comes under the classification known as "battle cruisers" which represents what may be expected to be in some measure the ultimate outcome of the present approachment in type between the battleship and the armored cruiser.

Steam Tug for Argentina.

The accompanying illustration shows the steam tug *Poderoso,* recently completed by Messrs. J. Thornycroft & Co., Southampton.

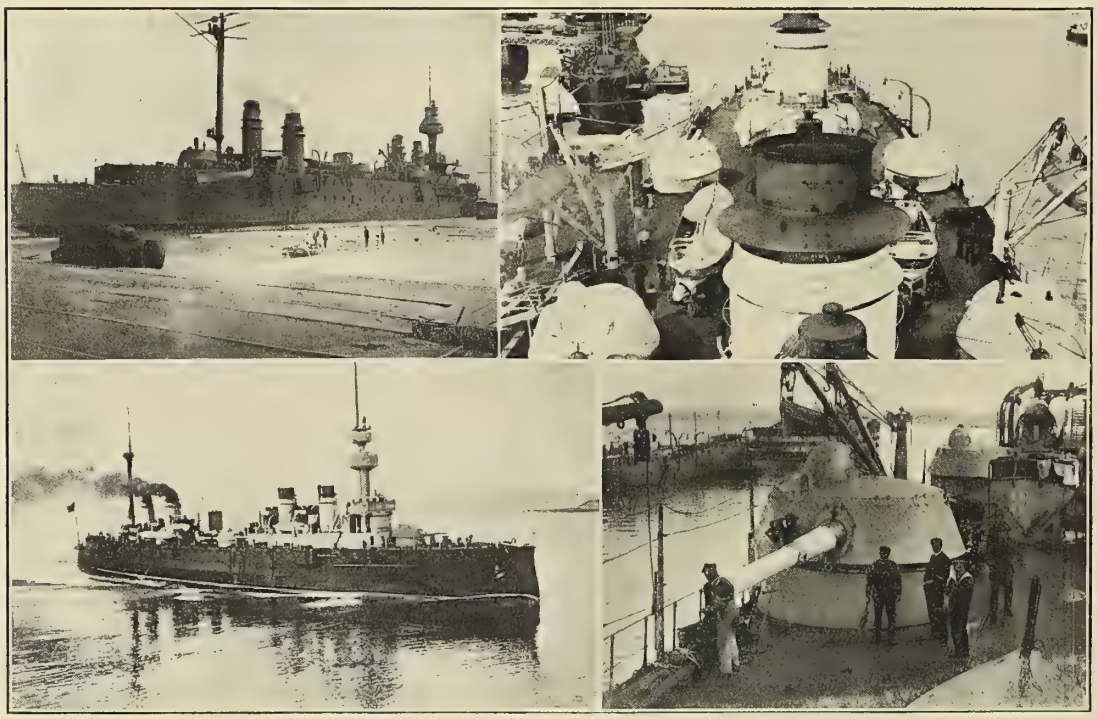


ARGENTINE TUG PODEROSO.

The order for this vessel was placed on July 20, the firm being under a guarantee to deliver the boat in twelve weeks from receipt of order. The tug was built, launched and officially tried in eleven weeks, and left for Buenos Aires under its own steam.

The dimensions of this single-screw tug are as follows: Length between perpendiculars, 75 feet; breadth molded, 18 feet; depth, 9 feet 3 inches.

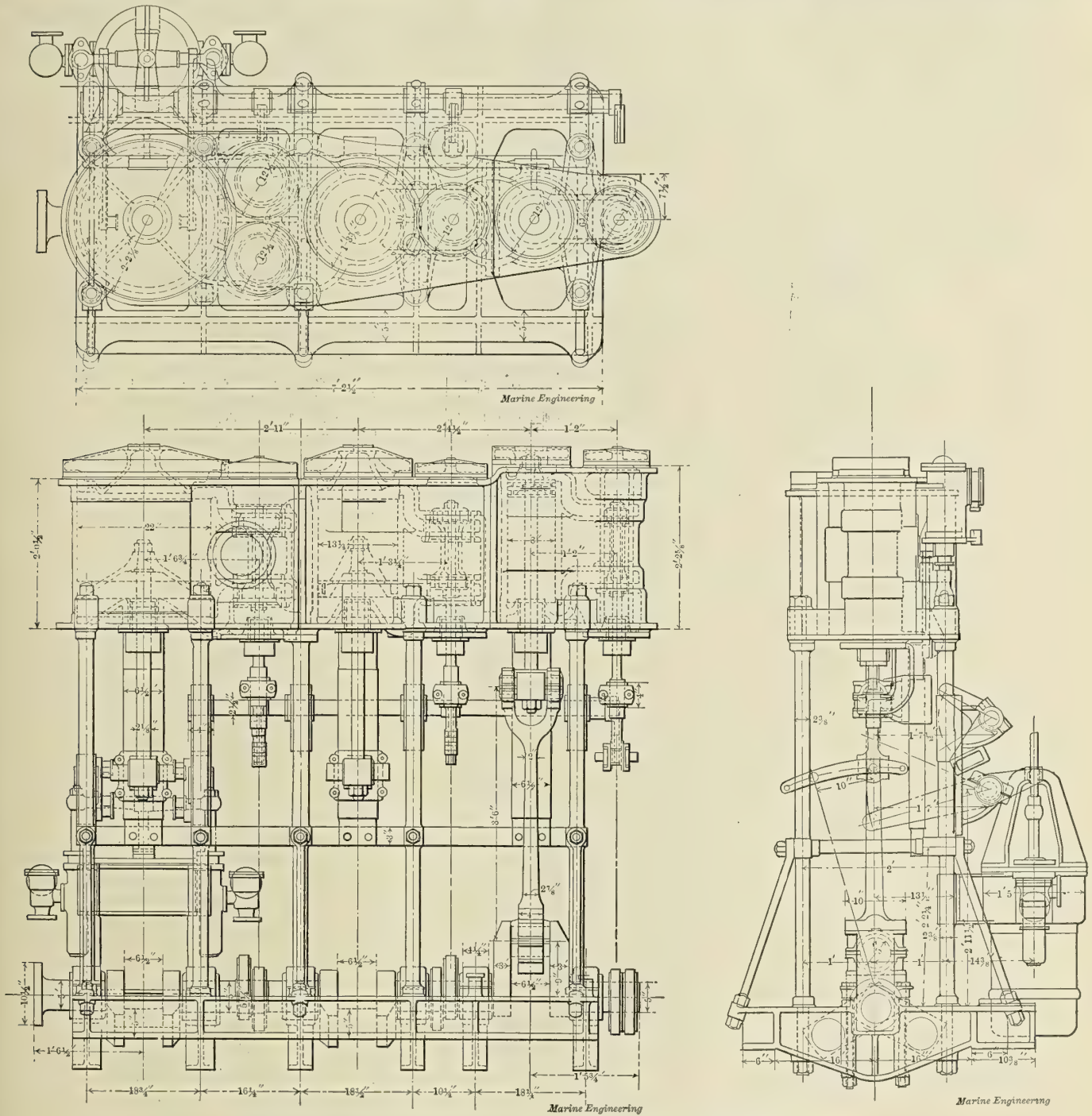
She is fitted with a compound surface condensing engine and return tube boiler, the cylinders being 15 and 30 inches in diameter by 22 inches stroke. The boiler is 10 feet 6 inches in diameter by 10 feet long.



ARMORED CRUISER AMIRAL AUBE, OF 10,014 TONS.

A NEW SHALLOW DRAFT REVENUE CUTTER.

For use on Albermarle and Pamlico sounds in North Carolina there has been designed a revenue cutter (No. 15) of about 408 tons cruising displacement, which is to make a speed of twelve miles per hour, with twin screw engines developing 600 horsepower. Advertisements have been issued for bids for this steamer, which will be placed in service as soon as it can be constructed.



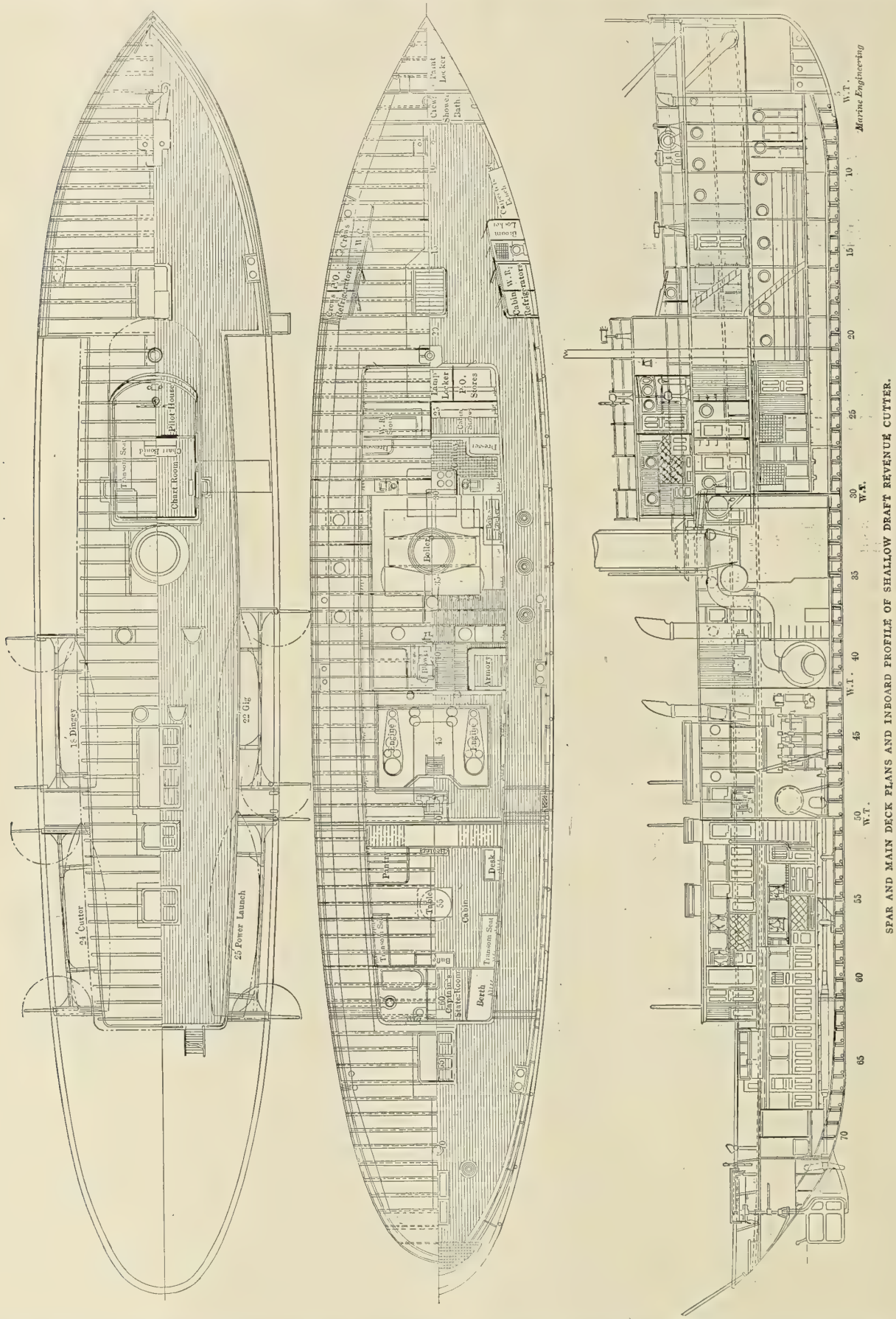
PLAN AND END AND SIDE ELEVATIONS OF MAIN ENGINE OF REVENUE CUTTER NO. 15.

THE HULL.

The length over all is 158 feet, length between perpendiculars 148 feet, breadth molded 30 feet, depth from base line at side 10 feet, and draft of water with normal supplies on board 5 feet. This corresponds, as above, to a displacement of 408 tons, and includes loads of 25 tons of coal and 2,400 gallons of fresh water. The total capacity for coal and fresh water are respectively 47 tons and 8,200 gallons. At the 5-foot load water line, the area of immersed midship section is 143.54 square feet, corresponding with a coefficient of 0.957; the area of the immersed longitudinal plane is 693.46 square feet; the area of the water plane is 3,345 square feet, corresponding with a coefficient of 0.735; the block coefficient is 0.644; and the area of wetted surface is 4,366 square feet. The additional displacement corresponding with added immersion of one inch, is 7.96 tons. The center of gravity of the ship under normal conditions when drawing 5 feet of water is 7 feet 11 inches above the base line, or 2 feet 11 inches above the water line, and is 3 feet ½ inch aft of frame 36.

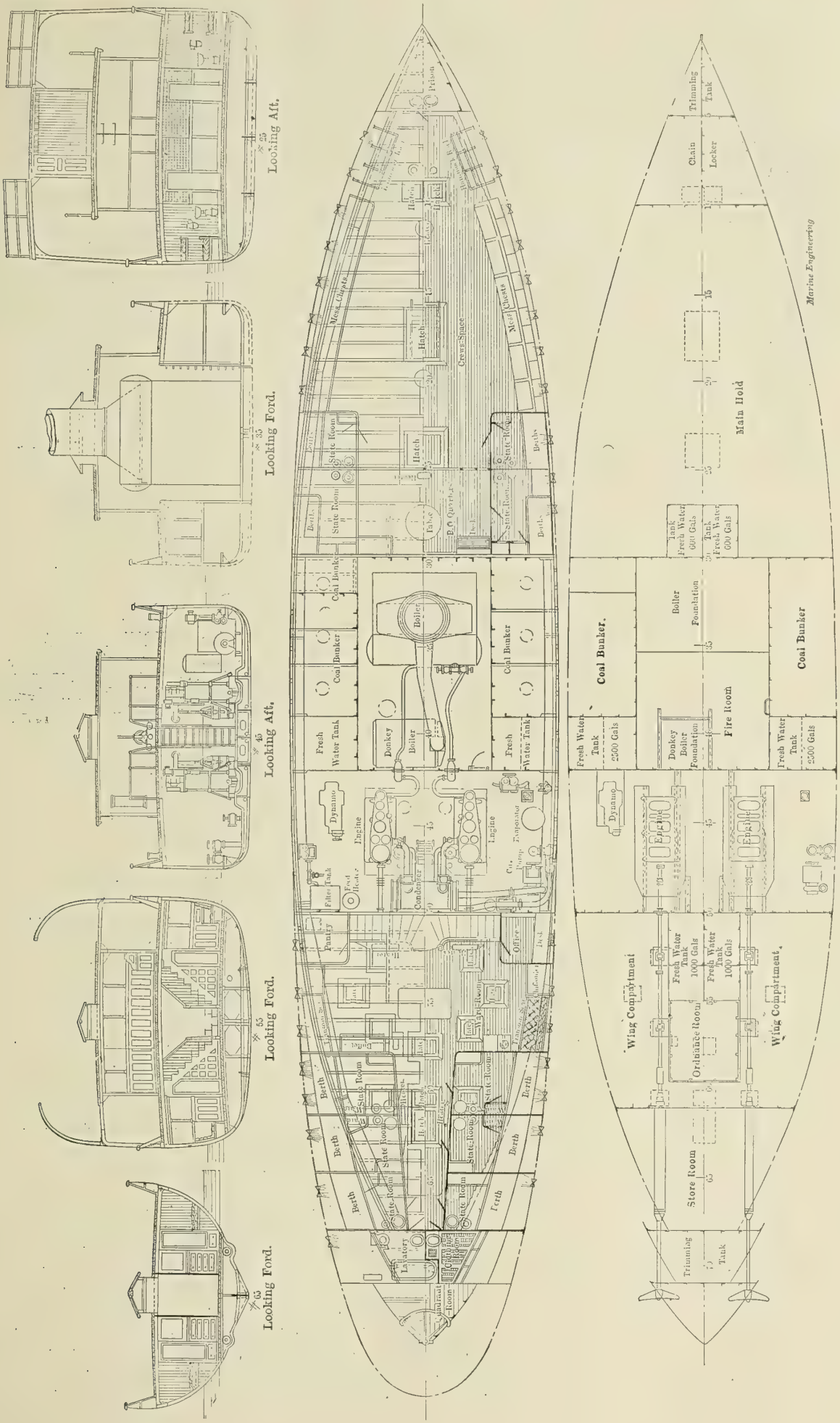
The keel is of the flat plate type, measuring 27 inches wide and 17 pounds thick, and is fitted in lengths of about 18 feet, with butt straps of 20 pounds treble chain riveted. A vertical keel is fitted inside with a thickness of 14 pounds and a depth of 17⅜ inches, extending 3¾ inches above reverse bar angles in order

to afford connection to two continuous longitudinal angles, 3½ by 2½ inches by 5 pounds. Continuous longitudinal angles to afford connection with same. Above the lower longitudinal bars are cut limber holes in this vertical keel, 3 inches in diameter,



SPAR AND MAIN DECK PLANS AND INBOARD PROFILE OF SHALLOW DRAFT REVENUE CUTTER.

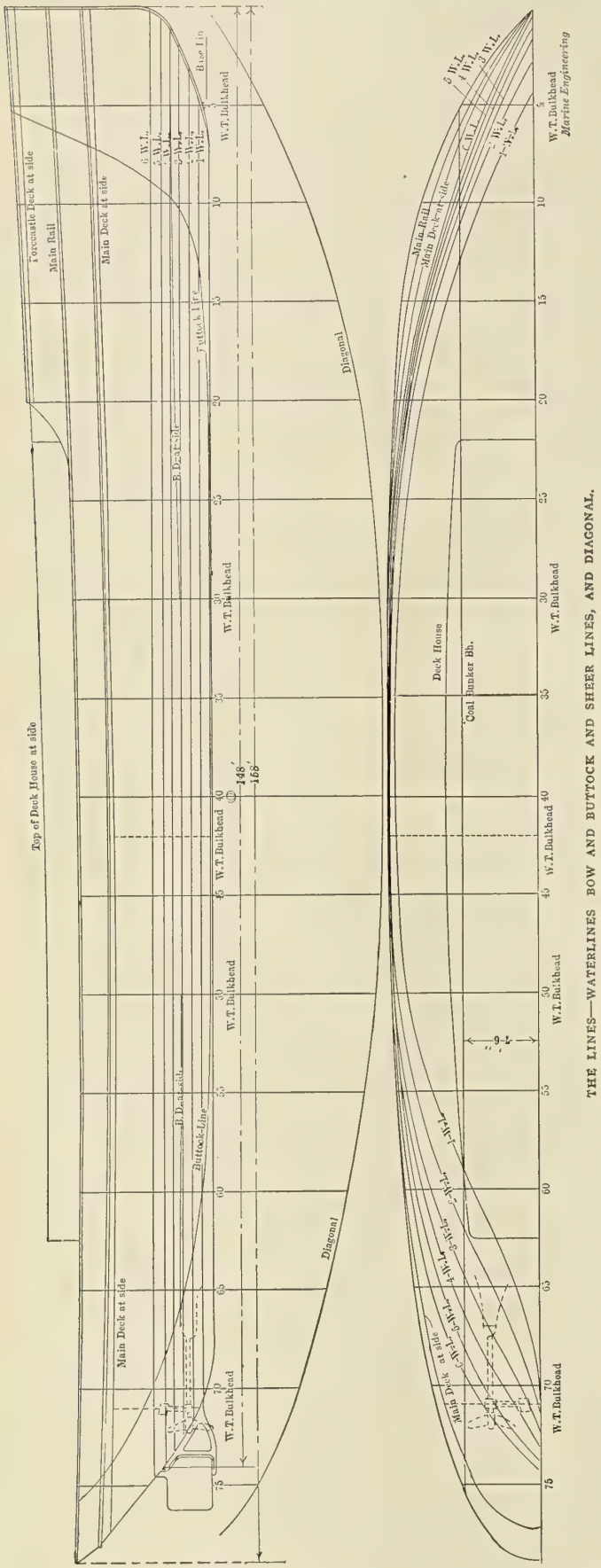
at its lower edge, 3½ by 2½ inches by 6 pounds, extend from stem to stern and connect it with the flat keel. Under the engine bedplate and thrust bearing this vertical keel is increased in depth one in each frame space. The stem is of hammered iron 6½ by 1¼ inches, in one piece, and rabbetted to receive ends of outside plating. The stern frame is of cast steel in one piece, molded



PLANS OF BERTH DECK AND HOLD, AND FIVE TRANSVERSE SECTIONS OF REVENUE CUTTER.

6½ inches and sided 1¾ inches.

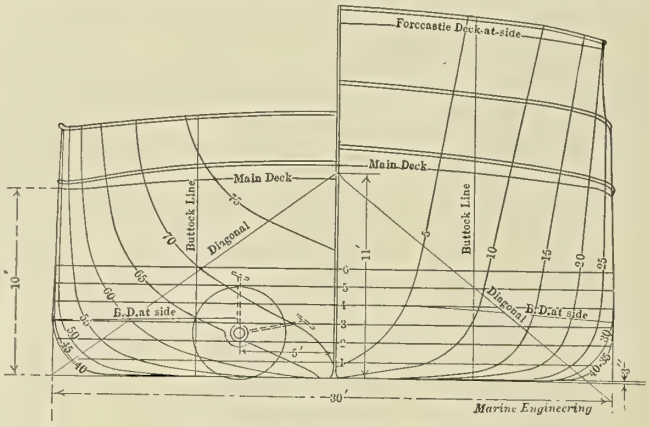
Transverse frames are spaced 24 inches between centers.



THE LINES—WATERLINES BOW AND BUTTOCK AND SHEER LINES, AND DIAGONAL.

From frame 20 to 55 they are 3 by 2½ inches by 5½ pounds; forward and aft the weight is 4½ pounds per foot. Under the engine are worked intermediate frames for local support. At transverse watertight bulkheads double angle bars of the same weight as midship frames are substituted for the regular frames. Reverse bars are fitted throughout, being 2½ by 2½ inches by 4 pounds amidships, and worked on alternate frames to underside of main deck stringer and 6 inches above upper bilge keelson. Forward and aft the weight is 3¾ pounds. In the engine and boiler spaces the reverse frames are doubled, one bar running to the main deck stringer plate and the other stopping at the turn of the bilge. The short bars pass through the vertical keel.

Floor plates are fitted amidships, 13 inches deep at the throat, and with a thickness of 12 pounds. The engine and boiler foundations are formed of floors with a weight of 14½ pounds per square foot, the depth being made suitable in each case. Forward and aft the floors are of 10-pound steel. All floors are lightened by holes, and are connected to the vertical keel with angle clips 3 by 2½ inches by 6 pounds joggled over reverse bars. Limber holes 4 inches in diameter are cut in all floor plates except at transverse watertight bulkheads. The floor forming the transom is 21 inches deep and 12½ pounds thick. Flat keelson plates are fitted, 6½ inches wide and 14 pounds thick,



BODY PLAN OF REVENUE CUTTER.

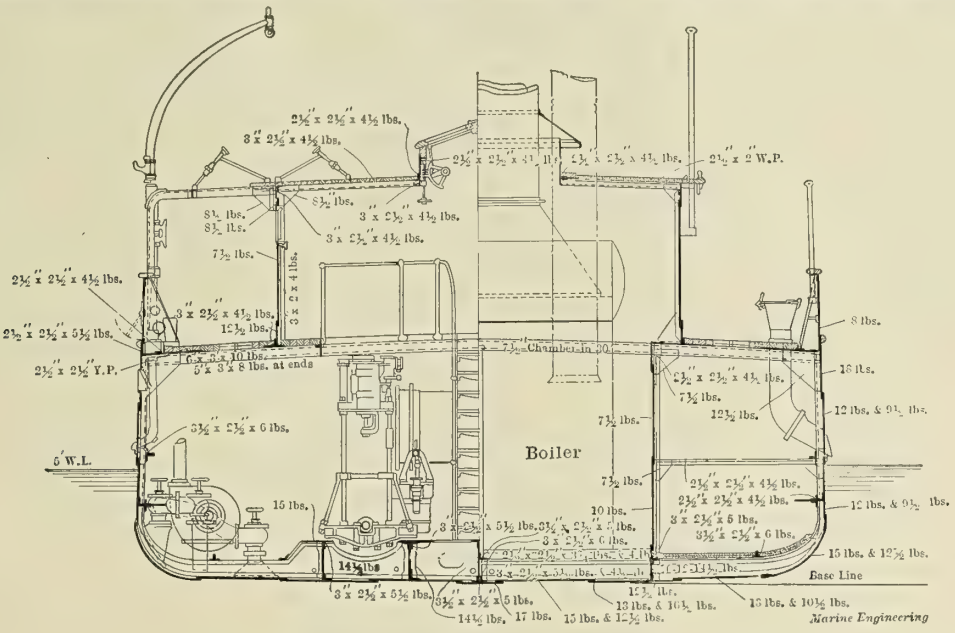
on each side of the vertical keel, extending from frame 5 to frame 71.

The main deck beams are bulb angles, with a spring of 7½ inches in 30 feet, and are fitted at every frame; they measure 6 by 3 inches by 10 pounds. At the extreme ends of the vessel the beams are reduced to 5 by 3 inches by 8 pounds. In the living spaces on the forward and aft berth decks the ends are split and turned down 15 inches, with a triangular piece welded in. In other parts of the vessel they are connected to the frames by bracket plates 7½ pounds thick. Berth deck beams consist of angle bars on alternate frames, and worked with a spring of 5 inches in 30 feet. At the sides of the vessel their tops are about 6 feet 9 inches below the tops of the main deck beams. They measure 3½ by 3 inches by 7½ pounds, and are connected to the frames and fore-and-aft bulkheads by 7½-pound bracket plates. Forecastle deck beams measuring 3½ by 2½ inches by 6.6 pounds are fitted at every frame aft of No. 5. Forward of No. 5 they are 3 by 2½ inches by 5½ pounds. All have a spring of 7½ inches in 30 feet, and have ends split and turned down 12 inches, with a triangular piece welded in the split.

One longitudinal is fitted on each side of the vessel, standing perpendicular to the outside plating throughout its length, and extending as far forward and aft as practicable. It is intercostal between the floors, and is made of 12½-pound plating. The upper edge extends above the reverse frame sufficiently to permit the securing to it of double continuous angles 3 by 2½ inches by 5 pounds. In the engine compartment there are substituted for this longitudinal two plates of 14½-pound steel, assisting in forming a foundation for the engine. Two keelsons are fitted on each side of the vessel, consisting in each case of double angle bars 3½ by 2½ inches by 6 pounds, and running as far forward

and aft as practicable. They are continuous, and are situated one above and the other below the turn of the bilge. In addition there is fitted a hold stringer, with double angle bars 2½ by 2½ inches by 4½ pounds.

The main deck stringer plates amidships are 28 inches wide by 11½ pounds thick. Forward and aft the thickness is 9 pounds and the width is gradually reduced to 15 inches. This is worked

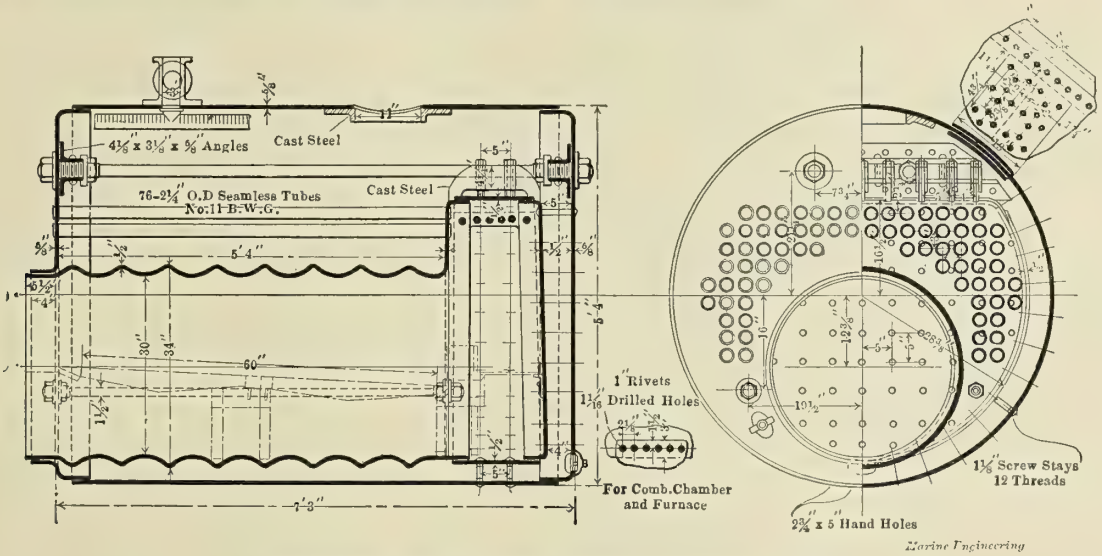


MIDSHIP SECTION, SHOWING SCANTLINGS.

in lengths of about 20 feet, with double chain riveted butts. Except on the forecastle deck, this is connected on the upper outboard side to the sheer strake by a continuous angle bar 2½ by 2½ inches by 5½ pounds. Under the forecastle deck intercostal angle bar clips of the same size are substituted. Continuous angles, 2½ by 2½ inches by 4½ pounds, are fitted to form a gutterway 10 inches in width, and to serve as backing for the deck

stringers. Under the windlass, bitts, gun, around the mast and across the ends of this deck 8½-pound plates are fitted. On each side of hatches are tie plates 10 inches by 7½ pounds.

Transverse watertight bulkheads are located, as shown, at frames 5, 30, 42, 50 and 71. The bottom strakes are 8 pounds and the upper strakes 6½ pounds. They are stiffened by vertical angle bars 3 by 2 inches by 4.1 pounds, about two feet apart; the angles to the deep bulkheads in boiler and engine spaces being five pounds per foot. The collision bulkhead has plates 10½ pounds thick on the bottom strakes and 8½ pounds over the upper half, and in addition to the usual stiffening has horizontal angle bars of the same size on the opposite side, and spaced about 4 feet between centers. Similar horizontal stiffeners are fitted also to the deep bulkheads.



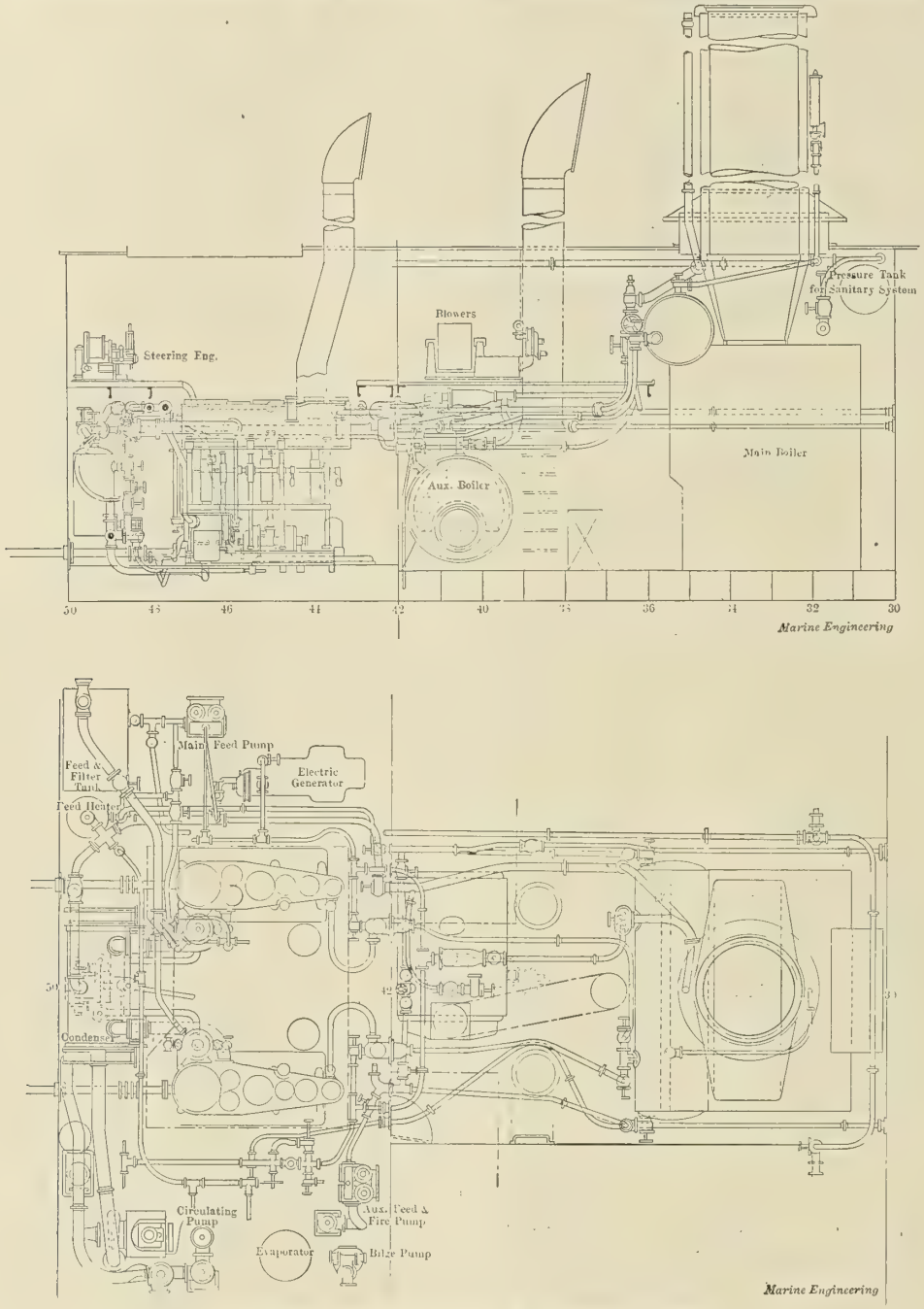
LONGITUDINAL AND TRANSVERSE SECTIONS OF AUXILIARY BOILER.

plank. Tie plates 10 inches by 10 pounds are worked on each side of hatches under deck house and over coal bunkers. At the ends of decks and around mast 10-pound plate is fitted. Berth deck stringer plates 18 inches wide and 9 pounds thick are fitted amidships, the thickness being reduced to 7½ pounds at the ends of vessel. Plating 7½ pounds thick is fitted between stringer plates at ends. Tie plates 10 inches wide by 7½ pounds thick are also fitted. Forecastle deck stringers are 15 inches wide and 7½ pounds thick, with 7½-pound plating fitted between the

The foundations for the main engines are built up from the framing of the vessel, of which they form a part. Deep floors 14½ pounds thick are worked under engines, boilers and thrust bearings, and are stiffened longitudinally by intercostal plates of the same weight, secured to floors and cap plate of engine foundations by angle clips 3 by 2½ inches by 5½ pounds. The cap plate is of 15-pound steel.

Outside plating, aside from the keel, consists of garboard strakes 15 pounds amidships and 12½ pounds at the ends;

bottom strakes weighing 13 and 10½ pounds respectively; bilge strakes of 15 and 12½ pounds; and side strakes of 12 and 9½ pounds. The sheer strakes for the entire length are 30 inches deep and 18 pounds thick. Bulwark plating and forecastle sides are 8 pounds thick. All plates are fitted in lengths of 18 to 20 feet. Doubling plates are worked at the bow for about 20 feet in length, and covering a space of 2 feet above and 2 feet below the load water line. Solid liners of thickness equal to that of adjacent plates are fitted between frames and outside strakes of plating.



LONGITUDINAL SECTION AND PLAN OF MACHINERY LAYOUT.

The main deck planking is of yellow pine in lengths of 25 or 30 feet and 2½ inches thick. The butts are underlaid with 8-pound plates. Forecastle deck planks and top of deck house are of white pine 2½ inches wide and 2 inches thick, except in wake of the 3-pounder gun, where it will be thickened. The berth deck planks are of white pine 2 inches thick.

The deck house has a base plate 11 inches deep and 12½ pounds thick, an upper coaming plate 10 inches deep and 8½ pounds thick, and intermediate vertical 7½-pound plating. Vertical angle bars spaced 2 feet apart measure 3 by 2 inches by 4 pounds, and carry angle beams 3 by 2½ inches by 4½ pounds, with a spring of 7½ inches in 30 feet. The tops are 7 feet above tops of main deck beams at side.

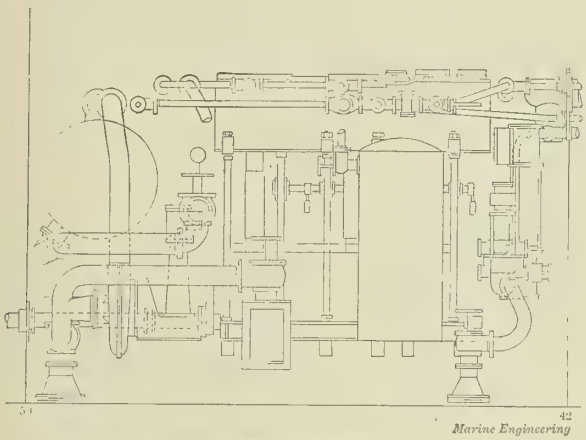
The pilot house and chart room are given a clear height under beams of 6 feet 6 inches. Coaming plates of 8½ pounds are fitted at top and bottom, with 5-pound vertical plates between. The vertical stiffeners are frames consisting of 2½ by 2 inches by 3.7-pound angles about 2 feet apart, and carrying angle beams 2½ by 2 inches by 4.5 pounds. The roof is of white pine 1½ inches thick, covered with tar felt and No. 2 canvas. The bridge is constructed by extending the roofing of the chart room out on each side, the ends being supported by angle iron stanchions.

The rudder frame is of wrought iron, the minimum diameter of head being 4¼ inches. The pintle measures 2¼ inches in net diameter, with a brass sleeve ¼ inch thick. The frame is filled in with white pine and covered with 7½-pound plate. Chock pieces are fitted to limit the angle of turning to 40 degrees on

each side of the center line. A quadrant on the rudder stock is connected with the steam steering engine by wire ropes and chains, appropriate connections to the steering wheel in the pilot house being made. Arrangements are made for steering from the pilot house, the bridge and the aft end of the main deck. The steering engine has two steam cylinders each 3½ inches in diameter by 3½ inches stroke.

THE EQUIPMENT.

Four boats are carried, being a 25-foot power launch, a 24-foot sailing launch, a 22-foot cutter and an 18-foot dingey. All are



INBOARD SIDE OF PORT ENGINE.

of hammered wrought iron, and rest in cradles. A single mast is fitted, measuring 64 feet over all, with a maximum diameter of 15 inches; it has a rake of 2 degrees.

There are two bower anchors of 800 pounds each, and two smaller anchors weighing respectively 200 and 110 pounds. The former are of the stockless type, and each is equipped with 75 fathoms of one-inch stud link chain. The anchors are handled by a davit about 4½ inches in diameter.

Six water tanks are fitted, two in the aft end of the fore hold having a capacity of 1,200 gallons; the two aft of the engine room bulkhead, 2,000 gallons; and two under the coal bunkers, 5,000 gallons. In each case the shell plating forms the bottom of these tanks, the other plating being 10 pounds thick.

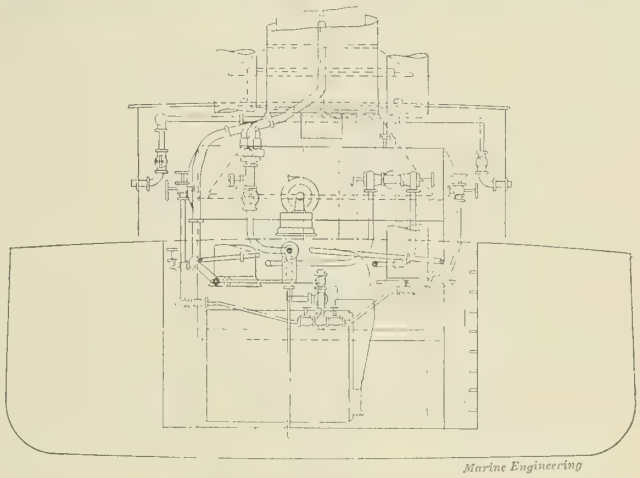
THE MACHINERY.

The main engines, which operate twin screws of 5 feet diameter, are of the vertical direct-acting triple expansion type, with cylinders 8, 13¼ and 22 inches in diameter, and a stroke of 18 inches. The indicated horsepower at 220 revolutions per minute will be about 600, the steam pressure being 200 pounds per square inch. The high pressure cylinders will be fitted forward and the low pressure aft.

The framing of each engine will consist of ten finished wrought steel columns, 2⅜ inches in diameter, efficiently stayed with tie rods. The bedplates are of cast iron.

The cylinder barrels have a thickness of ⅞ inch. Clearances at the ends of the stroke are ¼ inch at the top and ⅜ inch at the bottom. Each cylinder is fitted with a spring relief valve 1½ inches in diameter, loaded to gauge pressures of 225, 100 and 40 pounds respectively. Pistons are of cast steel with wrought steel followers, each being fitted with two packing rings of hard cast iron, held out by steel springs. The piston rods have a diameter of 2⅛ inches. Crossheads are of forged steel, with pins 2¾ inches in diameter, and 2¾ inches long on each side; slippers are of manganese bronze, with forward and backward sliding surfaces of 8 by 6½ inches. Connecting rods measure 42 inches between centers, and are turned to a diameter of 2 inches at crosshead end and 2⅞ inches at crank end.

Piston valves are fitted throughout, there being one for each high- and intermediate-pressure cylinder, and two for each low-pressure cylinder. The diameters are respectively 4¾, 6¾ and 7¼ inches, the thickness of working liners being ½ inch. The valves are single ported and of cast iron, finished all over. The valve gear is of the Stephenson type, with double bar links, and is so adjusted that the main cut-off under full gear at both ends of each cylinder will be about 72 percent of the stroke. The valve stems have a diameter of 1½ inches at the stuffing boxes, and 1⅛ inches where they pass through the valves. The eccentrics are made in two parts, and have an eccentricity of 1⅜ inches with a face of 2⅛ inches. Eccentric straps are of composition

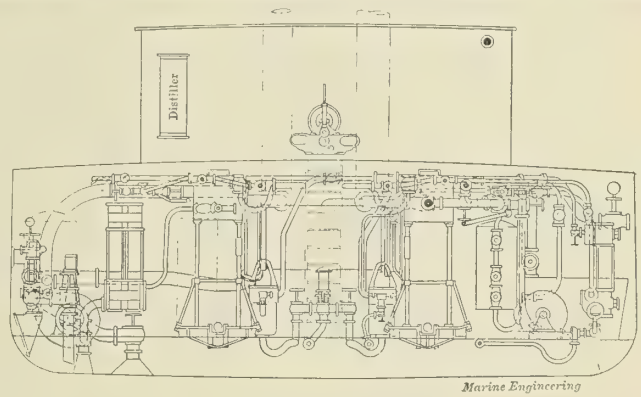


SECTION IN WAY OF BOILER ROOM.

lined with white metal. The eccentric rods measure 3 feet 4 inches from center of eccentric to center of link pin.

The cranks are set at an angle of 120 degrees, the throw being 9 inches. Crank pins are 6½ inches long with a diameter of 5 inches; crank webs, 6¼ inches wide and 3 inches thick, with ends chamfered. Each crank pin has an axial hole 2 inches in diameter. The crank shafts are solid, and in one piece, and measure 5 inches in diameter. Coupling disks are 1½ inches thick and 10½ inches in diameter.

The thrust shafts measure 4½ to 4⅞ inches in diameter, and about 12 feet in length. There are five thrust collars 1¼ inches wide and 10 inches in diameter, 1⅞ inches apart. The inter-



SECTION ACROSS ENGINE ROOM.

mediate shafts are 4½ inches in diameter and 11 feet 6 inches long, the aft coupling consisting of a sleeve 8 inches in diameter and 20½ inches long, bored with a double taper to fit intermediate and propeller shafts. The latter have a diameter of 4¾ inches and a length of about 26 feet.

The propellers will be manganese bronze, cast in one piece, the starboard propeller being right handed and the port left handed. Each will be held on the shafts by a composition nut covered by a watertight cap.

Each crank shaft will have six bearings, the forward three of which have a length of 5½ inches each, and the others 6 inches. The thrust bearings consist of cast iron pedestals

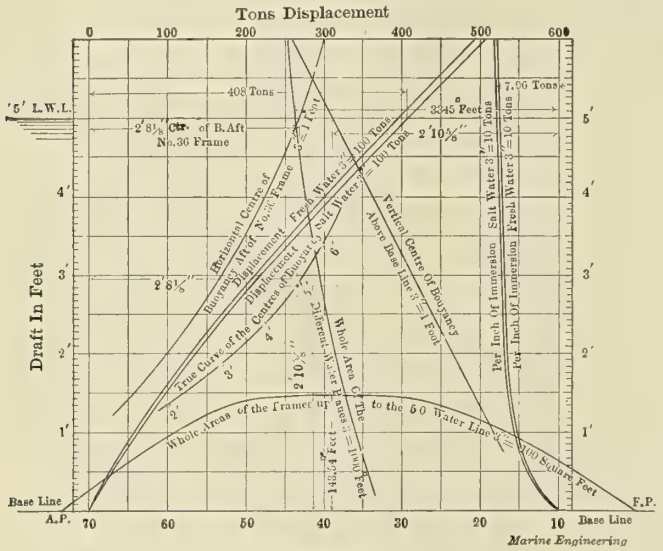
bolted to the foundation plates. Spring bearings are fitted for each thrust shaft. Stern tube bearings consist of a composition bushing made in halves, and fitted with sections of lignum vitae.

The reversing gear for each engine consists of a steam cylinder 4½ by 9 inches, with cast iron slide valve, and permits of an adjustment of the cut-off from 50 to 72 percent of the stroke. Turning gear is fitted for operation by hand.

AUXILIARY MACHINERY.

The one main condenser, which is independent, is fitted athwartship, aft of the engines, and has a cooling surface of 840 square feet. The shell is cylindrical, 5 feet 10¼ inches long and 3 feet inside diameter. It is made of steel ⅜ inch thick. The distance between tube sheets is 6 feet. The latter are of tobin bronze, ⅞ inch thick, stayed with ¾-inch rods of the same material. There are 858 seamless drawn composition tubes 6 feet 1¾ inches long, with an outside diameter of ⅝ inch and a thickness of No. 16 B. W. G. They are spaced $\frac{15}{16}$ inch between centers.

The list of pumps includes two main air pumps 13 by 7 inches worked from low pressure crosshead, with a 4-inch suction pipe from the condenser and a 3½-inch discharge pipe leading to main feed tank and overboard; one main circulating centrifugal pump



HULL CURVES.

with a 24-inch runner, and with two 7-inch suction pipes from sea and bilge respectively and a 7-inch discharge pipe leading to condenser and overboard; two main feed pumps 1¾ by 7 inches, worked from low pressure crosshead, with a 2-inch suction pipe from feed tank and a 2-inch discharge pipe to main feed; one main feed pump 7½ by 5 by 8 inches, duplex and independent, with a 2½-inch suction pipe from feed tank and a 2½-inch discharge pipe into main feed; one auxiliary feed pump 7½ by 5 by 10 inches, duplex and independent, with four 2½-inch suction pipes from feed tank, bilges, condenser and hose connection, and a 5-inch suction pipe from sea, and with four 2½-inch discharge pipes to feed tanks, condenser, auxiliary feed main and overboard, and a 3-inch discharge pipe to fire main; two bilge pumps, 1¾ by 7 inches, worked from low-pressure crosshead, with a 2-inch suction pipe from engine room bilge and a 2½-inch discharge pipe overboard; one distiller circulating pump, 8 by 5 by 10 inches, with a 3-inch suction pipe from sea and three 2½-inch discharge pipes to distiller, flushing system and fire main; one independent bilge pump, 4½ by 6 by 6 inches with a 2½-inch suction pipe from bilges and a 3-inch suction pipe from sea, and two 2½-inch discharge pipes, one to flushing system and the other overboard; an evaporator feed pump, and an air compressing pump 4½ by 5½ by 5 inches.

Piston rod and valve stem stuffing boxes will be made of composition and fitted with metallic packing, and will be provided with efficient means for lubrication. The stern tube stuffing box will be made in halves divided longitudinally, with a packing space 6 inches deep and 1 inch wide, and so fitted as to prevent rotation of the packing.

In each fireroom will be two 24-inch ventilators of No. 10 B. W. G. steel, fitted with cowls of the same thickness and 51 inches maximum diameter. Two engine room ventilators, 18 inches in diameter, will be of No. 12 B. W. G. steel, and extend about 8 feet into the engine room; the cowls, of the same material, will have a maximum diameter of 44 inches.

The one evaporator will have a capacity of 1,700 gallons of water per twenty-four hours. The one distiller will have a similar capacity. Steam radiators are fitted for heating, with about 30 square feet of radiating surface for each 1,000 cubic feet of the spaces to be heated.

In the engine room will be a feed water heater with about 75 square feet of heating surface and operated by auxiliary exhaust steam. The combined feed and filter tank will have a capacity of about 300 gallons, and will be made of wrought iron plates ¼ inch thick. It will have 50 pounds of zinc plate suspended from the braces in a wrought iron basket, to obviate pitting.

The main cylinders and valve chests will be covered with magnesia and lagged with Russia iron, the upper cylinder heads having false covers. The steam cylinders of all auxiliary engines will be likewise lagged. All steam and exhaust pipes and valves, separators, the feed water heaters, etc., will be covered with magnesia and canvas. The main condenser will be covered with hair felt and Russia iron, as will the evaporator. Boiler drums and other exposed parts will be covered with magnesia and galvanized iron. The magnesia covering will consist of 85 percent carbonate of magnesia and 15 percent asbestos fiber.

THE BOILERS.

The main boiler will be of the marine watertube type, in a watertight compartment, and will have a length of about 9 feet 3 inches, a width of 11 feet 9 inches and a height of 11 feet, measured over the casing. It will have a total grate surface of 75 square feet, a heating surface of about 3,105 square feet (ratio 41.4) and will be operated at a working pressure of 200 pounds per square inch. The length of grates will be 7 feet. Generating tubes will be straight. The steam and water drum will have a diameter of 42 inches.

An auxiliary boiler of the horizontal return fire-tube type designed for 200 pounds steam pressure will be 5 feet 4 inches in outside diameter and 7 feet 3 inches long. It will have one corrugated suspension furnace ½ inch thick, 30 inches inside diameter and 5 feet 10 inches long. There will be seventy-six steel tubes, No. 11 B. W. G., 2¼ inches outside diameter and 5 feet 4 inches long. The grate surface will be 12.5 square feet, heating surface 296 square feet, calorimeter area 1.75 square feet. The ratio of heating to grate surface will be 23.7, and of grate to calorimeter area 7.1 to 1.

The uptake and funnel will be of sufficient size to give at all points a clear area equal to at least one-seventh the grate area. The uptake will be of three thicknesses of steel plate with double spacing of two inches. The funnel, which will measure 48 feet in height above the base line, will consist of inner and outer casings 5 inches apart. The inner casing will be made of No. 7 U. S. S. G. plates in the lower half and No. 9 in the upper. The outer casing will be of No. 12 plates.

There will be one Sirocco fan blower driven by steam turbine, located in the boiler compartment. It is designed to run with a steam pressure of 100 to 120 pounds, and will be connected with ducts to the ashpits, and to the ventilating system of the vessel.

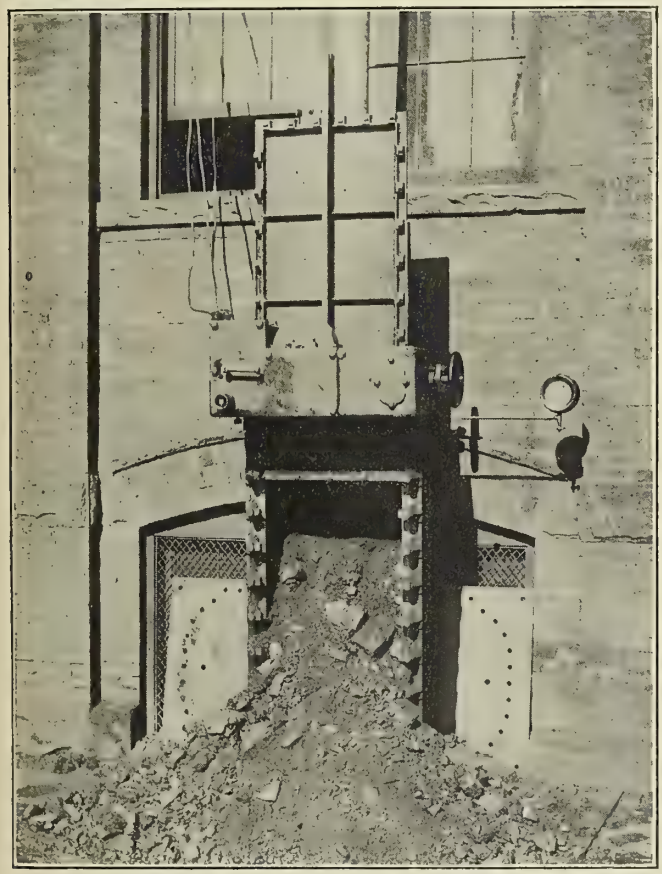
Main steam pipes will be of seamless drawn steel 3 inches in diameter, with 3-inch stop valves on the boiler. An auxiliary 3-inch steam pipe will connect from a stop valve on the boiler to a separator, from which two 2½-inch branches will be led.

Main exhaust pipes are of copper, 7 inches in diameter.

The main boiler will have a twin spring safety valve, with two valves 3 inches in diameter. The auxiliary boiler will have a single spring safety valve 2 inches in diameter. The springs will be of such a length as to allow the valves to lift one-eighth of their diameters, when they are set at 200 pounds pressure. They will have spherical bearings at the ends.

OFFICIAL TESTS OF ELECTRICALLY OPERATED BULKHEAD DOORS.

Ever since power operated bulkhead doors were introduced, there has been a good deal of speculation as to how these doors would work when called upon to cut through coal. How would they act under such conditions as prevail when the bunkers are full and coal of all sizes is distributed over the sill? In order to obtain information on these and other questions the United States Navy Department, through the Bureau of Construction and Repair, has lately conducted unusually elaborate tests of the Long-Arm system power door, as installed on United States warships.

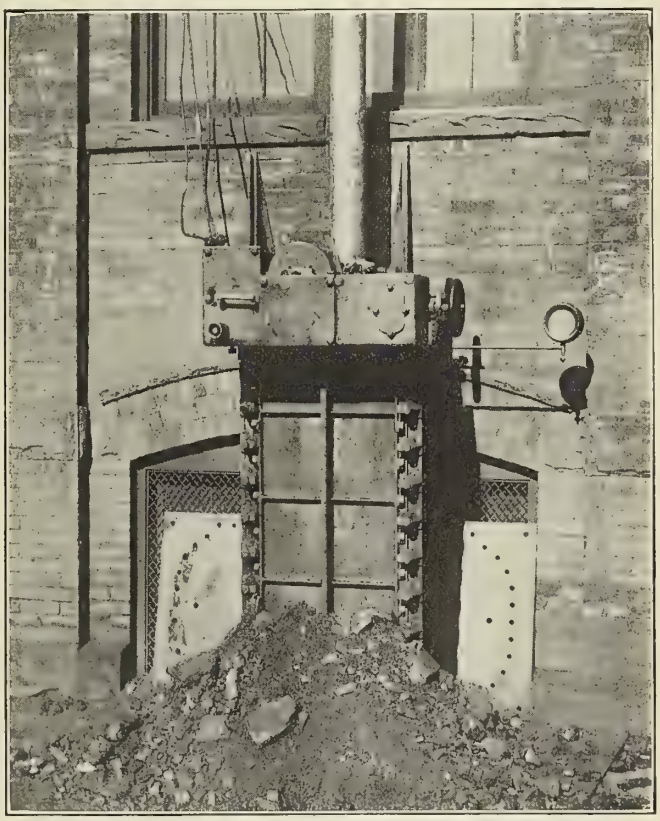


THE DOOR ABOUT TO CLOSE THROUGH COAL.

For the purpose of the tests were reproduced the conditions existing aboard ship when the coal bunkers are full and the doorways between the bunkers and the fireroom are open and choked with coal. The tests included also a reproduction of the situation which would arise in the event of a hull puncture admitting an inrush of water sufficient to sweep the coal through the doors.

Fanciful descriptions of "ponderous doors crashing through the coal" are responsible for much misconception as to the actual working of power doors under such conditions. As a matter of fact, no door has ever been built that would always cut through all the lumps of coal which might be in its path, and after that seat itself perfectly watertight. To be safe for the men working in the firerooms, a door operated from the bridge of the ship must close reasonably slowly, so that the men will have ample time to get out of its way. If the men fear the doors they will block them open, which condition completely foils the proper use of any power door. When a door operates at a safe speed, it can invariably be prevented from closing by a very large lump of coal, for it is practically impossible to bring sufficient force to bear upon the door plate to cut through everything that may come in its path. In some types of doors, their whole object has been defeated by the fact that the guides and tightening wedges are so constructed that they become clogged with fine coal dust, and the door in closing often becomes tightly wedged on this compressed dust and stops in a partly opened position. No power could close the door under these circumstances.

For the doors under test, there has been evolved, during an experience with hydraulic, pneumatic and electric power doors covering eight years, the most satisfactory design of guides and tighteners to prevent fouling by coal dust, and the most suitable thrust upon the door plate to secure efficient closure and the greatest safety to the ship. In these and other respects the Model C door now being manufactured is an evolution, for almost every valuable feature is the result of long continued sea service, coupled with the experience and close study of experts in this particular specialty. The official trials here described show that this type of door is equally suitable for coal bunker and passage openings.



DOOR CLOSED INTO COAL BY EMERGENCY SYSTEM.

GREAT ENDURANCE SHOWN.

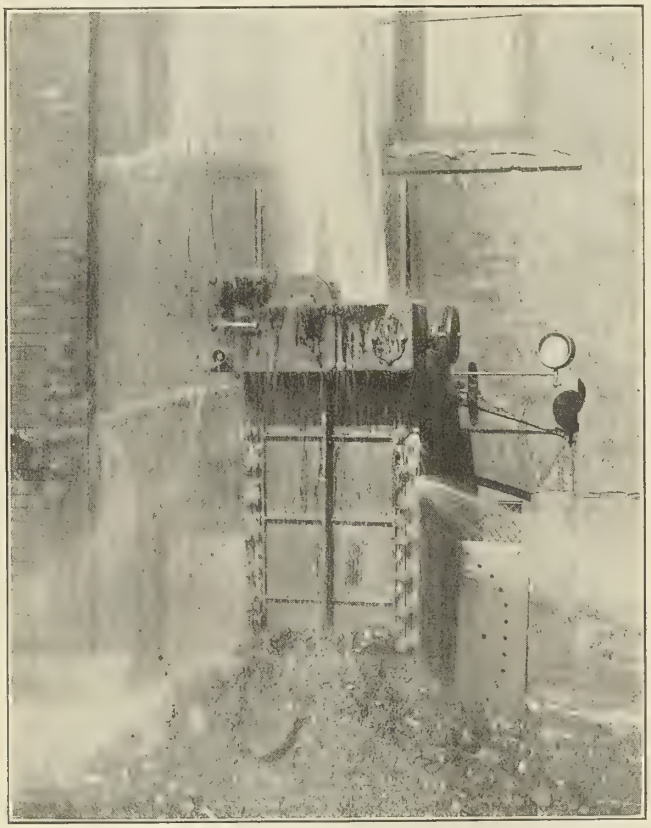
Before proceeding with the coal and water tests the door was operated continuously for a period of several days, during which time it was opened and closed over 3,000 round trips. The Bureau of Construction and Repair considered this test equivalent to ten years of actual service on a warship. During this severe trial all that was necessary to keep the door in perfect operative condition was to oil several of the bearings once a day; that is,

about once for each 700 round trips. The controller received no attention whatever, and the contact fingers were found in excellent condition at the end of the test; the motor also received no attention during the entire test. The worm and the worm-wheel, by which power is immediately applied to the door, were lubricated before the test started and not at all during the test; they were found in excellent condition at its completion.

The durability of the door is even more impressively demonstrated by the fact that immediately before making the trials for the Bureau, a duplicate of the prescribed tests was carried out by the company to make sure that everything would run properly. The result was that the particular door in question passed through a series of openings and closings equivalent to twenty years' actual service upon a warship, without showing appreciable wear.

CONDITIONS OF THE TEST.

In carrying out the tests the power door was secured to a steel box, which was intended to represent a coal bunker, and



LEAKAGE UNDER 35-FOOT HEAD, AFTER EMERGENCY CLOSURE.

connected by a large pipe with an immense tank upon the third floor of the building where the tests were conducted. At the lower end of this pipe was located a valve for controlling the flow of water; and also a gauge for measuring the pressure in the box, which could, if desired, be continuously maintained at 15.2 pounds per square inch, equivalent to a 35-foot head of water above the sill of the door.

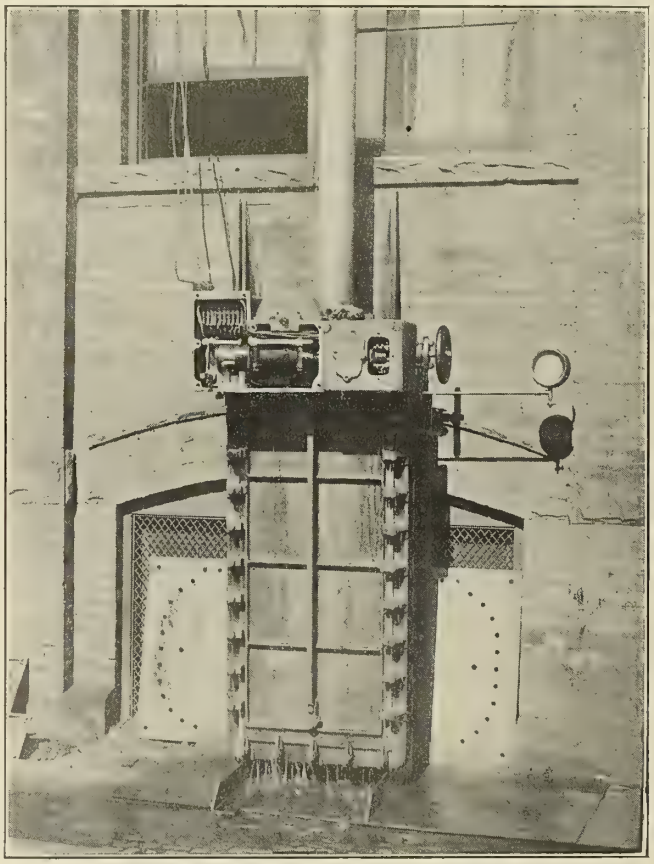
The box upon which the door was mounted was filled with coal, which was allowed to run out through the door opening in the same way that it would if the door were opened from a coal bunker. Large lumps of coal were mixed with the layer of all sizes. Before closing the door upon this mass of coal, fine coal dust was shoveled and thrown up all over the tighteners and the frame, in order that the conditions of the test might be as severe as possible. To make the coal dust stick in sufficient quantity, the bulkhead frame and tighteners were covered with thin oil.

The door was then closed from the bridge emergency station; the door plate cut through nearly all the coal, and the clear opening was practically completely closed when the automatic cut-out opened the circuit and stopped the motor.

In order to make this closure through coal possible it is essential that the door plate should work freely in sliding up and down, and not be forced against the bulkhead frame until it reaches nearly its completely closed position. At this stage the door plate was forced away from the bulkhead frame by the pressure of the coal, and the clearing space between the door plate and bulkhead frame was largely filled with fine coal dust.

SMALL LEAKAGE.

After the door had closed into the coal by the electric emergency action, and been stopped by the automatic cut-out, the water from the tank above was let into the box back of the door plate, and a head of thirty-five feet above the sill was maintained by adjustment of the valve. A thin film of spray



LEAKAGE UNDER 35-FOOT HEAD, COAL CLEARED AWAY.

worked its way through the clearance space between the bulkhead frame and door plate, and in some places the water succeeded in washing out the fine coal dust which had collected. At this time the actual leakage measured less than 75 gallons per minute. The water back of the door plate soon worked its way down through the coal to the slight opening at the bottom, and washed away the pile of coal in front, thus relieving the resistance to the thrust of the door plate, causing the automatic cut-out to throw in the current again, and allowing the door to complete its closure.

The escape of water, such as it was, would occur only on a coal-bunker door which could not completely close owing to fine coal collected upon the frame, and if the door plate did not ride freely in its ways and the clearances already referred to were not allowed, the plate would probably have stuck fast when only partly closed, and it would have been impossible to complete the closure except by opening the door and wiping it clean. It has been found by experiment that this clearance of

the door plate in its ways is an absolute necessity, in order to enable coal-bunker doors to come to a full close.

During another test the door was clean, as would be the case on a passage door, and the leakage under this condition is remarkably small. While this small leakage of a door closed in coal may seem undesirable, it is certain that any other type of door, if subjected to the same tests which the door under trial was put through, would fail to close the clear opening at all, while with the Long-Arm door the opening was safely closed (owing to the action of the automatic cut-out before and after the coal was washed away) and the leakage could be readily taken care of by the usual pumps.

PERFECT PROTECTION OF THE MOTOR.

It was clearly shown by the tests described that one of the reasons why this door works so perfectly on a coal bunker is because the motor is protected by an automatic cut-out which opens the circuit as soon as the load upon the motor becomes greater than it can safely handle, and when the load decreases to a safe amount the circuit is automatically closed again by the same device.

It is usual to protect motors with fuses in the incoming circuits, but these tests show that such means would not be suitable for a power door, for the reason that if it should strike an insuperable obstruction, such as hard packed dust or a large lump of coal in closing, and the fuse should be blown, the door would be absolutely inoperative (except by the hand gear) until some one could replace the fuse. The automatic cut-out is to the motor what the safety valve is to a boiler, except that instead of weighing the internal pressure of the boiler and giving relief when it exceeds a proper limit this cut-out automatically weighs the thrust exerted by the door plate, so that when this exceeds a predetermined limit the circuit is opened.

It was shown by the tests that the cut-out gives to the door an almost human intelligence in its action when operated from the emergency station. For instance, when the door closed into a mass of coal and struck a lump so large that it could not cut through it, the circuit to the motor was opened; but nevertheless the device was not inoperative, for when water got into the bunker back of the coal, it at once loosened the mass of coal beneath the door plate. As soon as this was done the pressure upon the plate was relieved, the circuit again closed, the motor again started and complete closure of the door was effected, as if the work had not been interrupted.

The principle upon which the automatic cut-out is based, and its mechanical construction are really very simple. The motor is directly connected to the worm engaging the wormwheel already referred to, which, in turn, transmits the load through its shaft and a pinion to a pin rack upon the door plate. In performing its work, the worm exerts a thrust in the direction of its axis, and this thrust is borne by a specially constructed bearing supported by a heavy helical spring. This spring has upon it an initial load equal to the greatest thrust which it is desired that the motor shall deliver. As soon as the thrust actually exerted by the worm exceeds the initial compression upon the spring the latter gives way slightly, allowing the wormshaft to move axially. This motion of the wormshaft is used to interrupt the circuit, and the same motion in the reverse direction (when the excess load is removed) will complete the circuit which it has previously broken.

The Bureau of Navigation reports that there were constructed in the United States during the month of February, 54 vessels of a total of 21,586 gross tons. Of these, 7, of 16,200 tons, were steam vessels constructed of steel. Two of the total were of over 6,700 tons each, and were constructed on the Great Lakes. The remaining 52 ships had an aggregate of 7,906 tons, or an average of 152.

MODERN PRACTICE FOR FIRING WATER TUBE BOILERS IN LARGE VESSELS.

BY H. C. DINGER, U. S. N.

The usual method of firing Scotch boilers with natural draft, using 12 to 15 pounds of coal per square foot of grate, was to allow each fireman to regulate his own fires. Fires were carried somewhat higher in front than in back, green coal was put on the front and the gases allowed to distil and pass over the live coals at back, the coal gradually being worked back. Fires were raked and sliced at intervals and cleaned in rotation.

With large water tube boilers, where the furnaces are wide and it is necessary to burn as much as 50 pounds of coal per square foot of grate per hour, this older method of firing does not answer the purpose with satisfactory results.

When such large amounts of coal per square foot of grate are to be burnt it is naturally necessary that every part of the grate be brought into use for actual combustion, and for this reason the clear, live fire must extend over the entire grate. In order to avoid holes in some parts of the fire and the accumulation of thick masses of green coal in others it is necessary to carry the fire level over the whole grate. Holes in the fire allow an extra amount of cold air to be admitted above the fire. This cold air cools the gases and causes smoke. In order to enable a proper amount of air to penetrate the layer of fuel so as to completely burn it, the fires must be carried thin, that is, six or seven inches thick. If not carried thin the air will fail to come in contact with a large part of the coal, and combustion is checked and incomplete, resulting in the formation of smoke, unburnt gases and carbon monoxide.

The great losses in firing are—

(1) The unconsumed coal which drops through the grate and falls into the ash pan, extra losses being caused by excessive slicing;

(2) Unconsumed fuel which passes up the stack in the form of smoke;

(3) Formation of carbon monoxide, CO, instead of carbon dioxide, CO_2, due to lack of sufficient air at various points of the fire. When coal is completely burned to CO_2, 14,500 heat units per pound of carbon are obtained; when CO is formed only 4,400 heat units are extracted.

To overcome the first of these losses, slicing must be avoided as far as possible, and in practice it can be avoided much more than is usually supposed. Slicing is done to break up the clinker and to allow the air to get at the mass of coal. If the formation of clinker is avoided the necessity for slicing is decreased. With light fires clinker will form much less readily than with heavy fires. A tendency to clinker can also be checked by breaking up and raking the fire with a leveling hoe from above.

Smoke, one of the results of incomplete combustion, is caused by an insufficient local supply of air, and by a cooling of the gases before combustion is completed. The latter condition can be avoided in part by not opening furnace doors while there is green coal on the fires. An extra supply of air at points where there is likely to be a deficiency can be obtained by admitting air on top of the fire. This is usually done through either the furnace door or the dead plate. The system of admitting air through the dead plate is preferable since in this way the air as supplied is first heated before reaching the fuel.

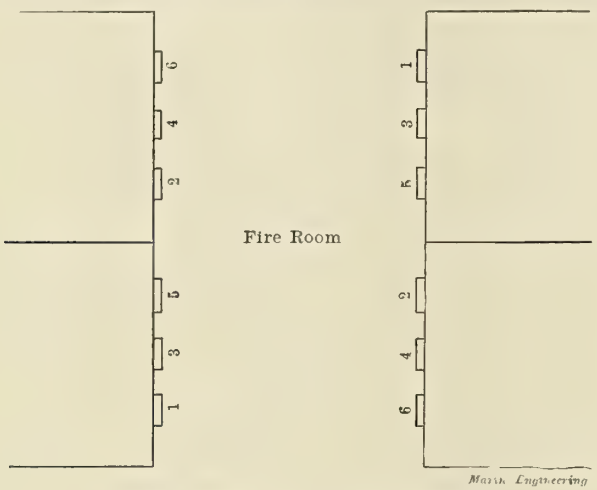
A lack of proper air supply at local points of the fire is also caused by having thick or uneven fires. The air is unable to penetrate the thick masses of green coal and hence does not come into proper contact with these portions of the fuel, which then give off large quantities of smoke on account of the gases being distilled but not burnt. To avoid this fires must be carried evenly all over the grate; they must be carried light; they must be fired

lightly and often, and in regular rotation. Large lumps of coal must not be put into the furnaces.

In general, to arrive at proper conditions of firing it will be necessary to observe the following:

1. Carry an even fire all over the grate, not over seven inches thick even with two or three inches air pressure.
2. Fire the whole grate evenly so that each part may get the same supply of coal.
3. Keep the fire continually level.
4. Avoid throwing in lumps larger than a man's fist.
5. Fire only small amounts of coal at any one time, so as to avoid a thick mass of green coal at any point or for any period of time.
6. Fire quickly and keep furnace doors open as little as possible.
7. Scatter coal thoroughly when it is put on, so that a layer of green coal can not be formed at any point of the fire.

The formation of carbon monoxide is caused by lack of sufficient air at portions of the fire. A proper supply of air above the fire will enable the CO to take up the other atom of oxygen in the combustion chamber or above the back of fire if the furnace is large enough at that point. With furnaces having a combustion chamber or a high furnace at back it is possible to have the combustion completed before the gases strike the tubes. Sometimes the complete combustion takes place in the uptake or smoke stack, and is called secondary combustion or flaming



FIRING DIAGRAM FOR MARINE BOILERS.

at funnel. This secondary combustion causes a very high temperature in the stack. It can be readily seen that the formation of CO is much more likely with heavy thick fires or uneven fires, and can be avoided by carrying clean, even and light fires.

SYSTEM OF FIRING.

In order that all the firemen may readily keep a uniform fire, and that the same amount of coal may be consumed in each furnace, a regular system of firing must be established and controlled by a central authority. A system for doing this will now be described.

On the large armored cruisers and battleships in the navy the boilers in any fireroom are arranged to face each other, there being either four, five, or six furnaces on each side. The furnaces are given numbers as in the diagram.

This arrangement is adopted so that when the furnace doors are fired in rotation according to the numbers, no two fires in any one boiler or half of a boiler are fired one immediately after the other. The men do not interfere with each other, since the fires to be fired at the same time are widely separated, and the firemen alternate with each other in firing and taking a spell of rest, the numbers being arranged with these special ends in view. A fireman is assigned to each three adjoining fires or to two adjoining fires, which are leveled a short time before being fired. For leveling and breaking the fire up from above a light long-handled hoe is used.

In starting to fire on this system No. 1 furnace is fired first; immediately after this No. 3 is leveled. Then at an interval, about one minute, No. 2 is fired and No. 4 leveled. Another interval, and No. 3 is fired and No. 5 is leveled. Then No. 4 is fired and No. 6 is leveled; No. 5 fired and No. 1 leveled, and so on in regular rotation.

No more than five shovelfuls are allowed to be thrown into the furnace at one firing and in every case only sufficient to keep the fire at its proper height is put on. The coal must also be scattered evenly all over the fire.

By carrying out this system fires are leveled about two minutes before coal is thrown on. This allows a good surface to be formed for the reception of the green coal. The leveling prevents the formation of hills and holes in the fire and checks the formation of clinker. Leveling must be understood to mean an actual leveling of the whole fire and breaking up of clinker by the use of the hoe from above, but does not mean the shoving back of the coal against the bridge wall.

Firemen are warned not to use the slice bar unless it is absolutely necessary to break up the clinker. Slicing is done during the firing intervals whenever necessary.

In order to have a means for maintaining an accurate firing interval, timing devices of various kinds are used. These devices usually consist of a light and a number, or a gong and a number, lighted or rung at regular time intervals, so as to indicate the time for firing the furnace whose number is shown. Among these are Kilroy's stoking device, largely used in the British navy, and one used in the Italian navy. A home-made device of this character is described by Lieutenant Lackey in the September, 1905, *Proceedings of the United States Naval Institute.*

The specifications for such firing device for the new vessels of the United States Navy are as follows:

There will be in each fireroom an electrical device for regulating the intervals of firing the furnaces. They will be adjustable to give any desired interval between firing. The device will consist of a cylindrical case with a dial perforated with openings equal in number to the number of the furnaces in its fireroom; each opening will be covered with an opaque glass having a number on it left clear, each number corresponding to a furnace.

Behind the glazed opening there will be electric lights which will be switched on and off successively by an electric motor located in the after fireroom. This motor will run continuously, and will be so arranged that all lights on the same side of the ship having same number will be illuminated at the same instant, to be followed by the lights of the same number on the other side, and so on till all the furnace numbers have been illuminated.

There will be a gong in each fireroom to call attention to the number displayed.

SMOKE PREVENTION.

The prevention of smoke in water tube boilers is mainly a question of proper firing. By carrying the fires light and even, firing light and often and avoiding the dumping of thick layers of green coal on the fires, supplying air above the fire and keeping furnace doors closed except when necessary for throwing on coal, smoke can be greatly diminished and almost avoided.

It is however a most difficult task to make firemen, especially those used to Scotch boiler practice, keep their fires in the non-smoking condition, but the increased economy and reduction in actual labor of handling the coal will amply repay any extra trouble necessary to establish the improved system.

Japanese Naval Additions.

The Japanese are felicitating themselves upon the launching on December 26 of the large armored cruiser *Tsukuba,* which has a displacement of 14,000 tons. This is the first armored

cruiser built in Japan, and by a considerable margin the largest ship ever built in that country. She is to be an extremely powerful vessel, the armament as at present understood consisting of four 10-inch and twelve 8-inch guns. It is just possible, however, that two 12-inch guns may be substituted for the four 10-inch, in which case she would have the same battery as the *Vittorio Emanuele,* the famous design of Col. Cuniberti. The speed is not known, but as she comes under the head of an armored cruiser, it will probably be not less than 22 knots.

In this connection it might be mentioned that the Japanese are engaged in a very extended program for additions to their navy, the ships including two large battleships recently launched in England; one battleship of 18,000 tons, to be laid down at the dockyard at Yokosuka, and another at Kure; the *Tsukuba,* which was laid down in February, 1905; the *Ikoma,* laid down in December, 1904; the *Ibuki,* to be laid down at Kure, and the *Kurama* at Yokosuka. The last four ships are armored cruisers of the same size.

The Battleship Rhode Island in Commission.

On February 19 the new first class battleship *Rhode Island,* constructed by the Fore River Shipbuilding Company of Quincy, Mass., was placed in commission at the Boston Navy Yard. The *Rhode Island* was authorized by act of congress June 7, 1900; contract for her construction was signed February 15, 1901; the keel was laid May 1, 1902, and the ship was launched May 17, 1904. The contract price for hull and machinery was $3,405,000.

The *Rhode Island* is the first to go into commission of five battleships carrying superposed turrets, these being the only battleships with this arrangement at present under construction, and, with the exception of the *Kentucky* and *Kearsarge,* the only such ones which have ever been built. The length is 435 feet on the water line (441 feet 3 inches over all); the beam is 76 feet 2½ inches, and the displacement on mean draft of 23 feet 9 inches is 14,948 tons. This includes normal coal supply of 900 tons. With the full supply of 1,700 tons, and with a complete equipment of stores and ammunition, the ship will displace 16,094 tons. The added displacement per inch of immersion at normal draft is 60.95 tons, giving a draft with full load of 25 feet 4 inches.

The ship is propelled by twin screw engines, designed to develop 19,000 horsepower and give her a speed of 19 knots. This latter was slightly exceeded on trial. The engines are of the four cylinder, triple expansion type, with cylinders 35, 57, and 66 and 66 inches in diameter, and a common stroke of 48 inches. Steam is supplied by twelve Babcock & Wilcox boilers with an aggregate of 1,342 square feet of grate surface and 56,184 square feet of heating surface, the ratio being 41.8 to 1.

The ship has an extremely powerful battery, exceptionally well arranged. It includes four 12-inch and eight 8-inch rifles; twelve 6-inch rapid fire guns; twelve 3-inch; twelve 3-pounders; eight 1-pounders; eight machine and two field guns; with four submerged 21-inch torpedo tubes. The arrangement of the battery is such that the broadside includes four 12-inch and six 8-inch guns, while fore-and-aft fire includes two 12-inch and six 8-inch guns.

The armor belt amidships has a thickness at the top of 11 inches, tapering to 8 inches at the bottom. Barbettes for the 12-inch guns have a thickness of 10 inches on the exposed sides and 7½ inches in the rear; those for the 8-inch guns are respectively 6 and 4 inches in thickness. Turrets for the 12-inch guns have front plates of 12 inches and rear plates of 8 inches in thickness, while the 8-inch guns have turrets 6½ and 6 inches thick. The protective deck amidships has a thickness of 1½ inches on the flat, 3 inches on the slopes, with a 3-inch thickness forward and aft. The complement of officers and men numbers 812.

THE UNITED STATES BATTLESHIP RHODE ISLAND, COMMISSIONED FEBRUARY 19, 1906.

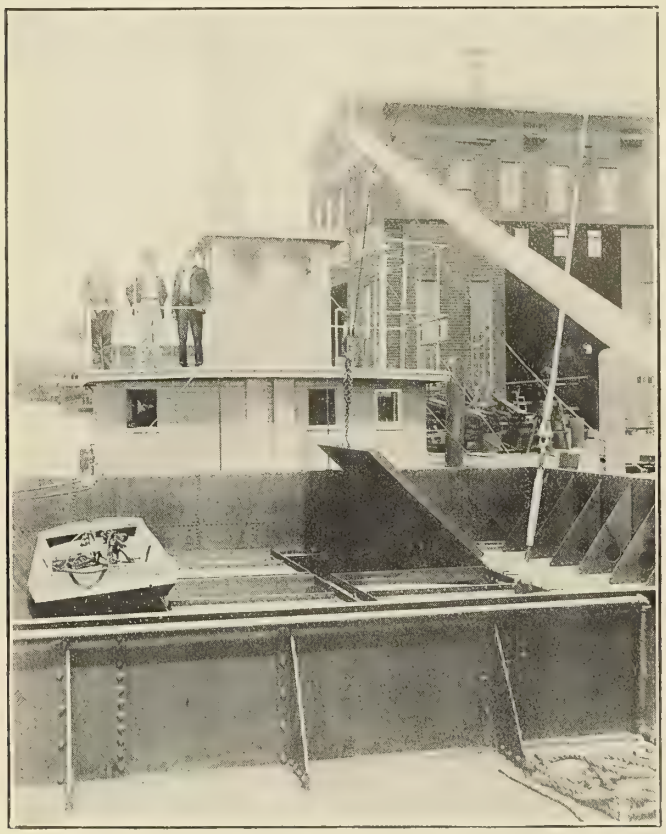
Ship owners will be interested in the repeal on February 22 of the act permitting the registration or enrollment under certain limitations of a foreign vessel wrecked in United States waters. As the law now stands, no such vessel can be placed under the American flag except by special act of congress.

A SELF PROPELLING ASH, COAL AND WATER BARGE.

"United States Navy water barge No. 14," which recently left the yards of its builders, the Pusey & Jones Company, Wilmington, Delaware, to enter upon its service at the United States coaling station, Guantanamo, Cuba, has embodied in its construction some novel features. This boat has been designed to carry both coal and fresh water to vessels in the harbor, and to take from them ashes, which can then be dumped overboard where the accumulation will not tend to obstruct navigation.

The general dimensions are: Length over all, 80 feet; beam, 30 feet; depth, molded at hopper, 7 feet; depth, molded at ends, 8 feet 9 inches; length of hopper, 35 feet.

The barge is of heavy construction and draws 2 feet 9 inches in running condition ready for cargo, with a capacity on a draft of 5 feet of 124 gross tons. The space available for the various kinds of cargo is about as follows: Ashes, 7,500 cubic feet; coal,



DECK VIEW OF BARGE NO. 14.

5,000 cubic feet (119 gross tons); fresh water, 3,600 cubic feet (100 gross tons); salt water ballast, 1,660 cubic feet (47.5 gross tons). Accommodations are also provided for miscellaneous cargo in the fore hold. The cuts show the locations of the various compartments.

Coal can be loaded and unloaded by means of the cargo boom or in any way desired. This boom is of one ton capacity, and is operated by a hoisting engine. It is also used to lift the doors which form the bottom of the coal bunker when the boat is to be used for carrying ashes.

A four-inch plug in the deck amidships port and starboard admits water to the fresh water tanks, and valve opening to the sea below the waterline admits salt water to the ballast tank.

The eight dumping hole doors are operated as shown, four from the engine room and four from the forward hold. Each set can be raised by one man as if it were but one large door. The doors are released by a blow on a pawl and the ashes drop into the sea.

A large duplex pump is furnished to pump fresh water from the tanks to vessels, to pump the salt water overboard, to wash out the ashes and clean up generally, and to drain the forward and after bilges. Check valves on the fresh water tanks keep the salt water out of them. After the pump has been used for salt water, a few strokes of fresh water pumped overboard will clean out whatever salt remains in it, and the short distance of piping common to both systems, and no salt water will get into the tanks to which the barge is supplying water. Water may be taken from either or both of the fresh water compartments, or from either or both of the salt water compartments, at one time. The deck plugs for hose connection are on either side of the house aft, and hose is supplied both for the supplying of fresh water to vessels and for washing decks.

The house aft contains two cabins with two berths apiece, and a galley fitted out complete. The outfit in general includes boat davits and an anchor davit, two 680-pound anchors and 120 fathoms of $\frac{13}{16}$-inch chain, and mooring bitts and cleats, as shown.

THE BARGE AFTER BEING LAUNCHED.

The barge is propelled by two 50-horsepower compound surface condensing engines, steam for which is supplied by a Scotch boiler, 6 feet 8 inches diameter and 9 feet 8 inches long, at 150 pounds working pressure. The engines are widely separated, but their operating levers are brought close together near the center line. A different tone of bell for each engine enables the engineer to operate them independently in any way desird. It will be noticed that the boiler is placed athwartship, balanced by the location of the coal bunker, fresh water tank and most of the auxiliaries to port.

A trial trip on the Delaware river proved the boat to be in every way satisfactory. It was towed out through the tortuous channel from the works of the builders to the open river, and after proving that with both screws going ahead it could turn in a small radius, and with one going ahead and the other astern turn completely around while in practically the same place throughout several revolutions, it navigated its own way back to the wharf. The trial with and against the tide over the measured mile course showed an average speed 6.7 miles per hour with 130 tons displacement, and 5.7 miles with 233 tons displacement.

H. H. T., Jr.

The New Battleships.

Editor, Marine Engineering:

Twelve months have passed since the navy bill of last year became a law, and all that time has been consumed by bureau chiefs in drafting plans and destroying them.

Differences of opinion among these heads, regarding the amount of space and weight to be alloted to each vessel for boilers, engines, coal bunkers and other features are responsible for this condition of affairs. This controversy has aroused a decided feeling of hostility in congress against the navy—or

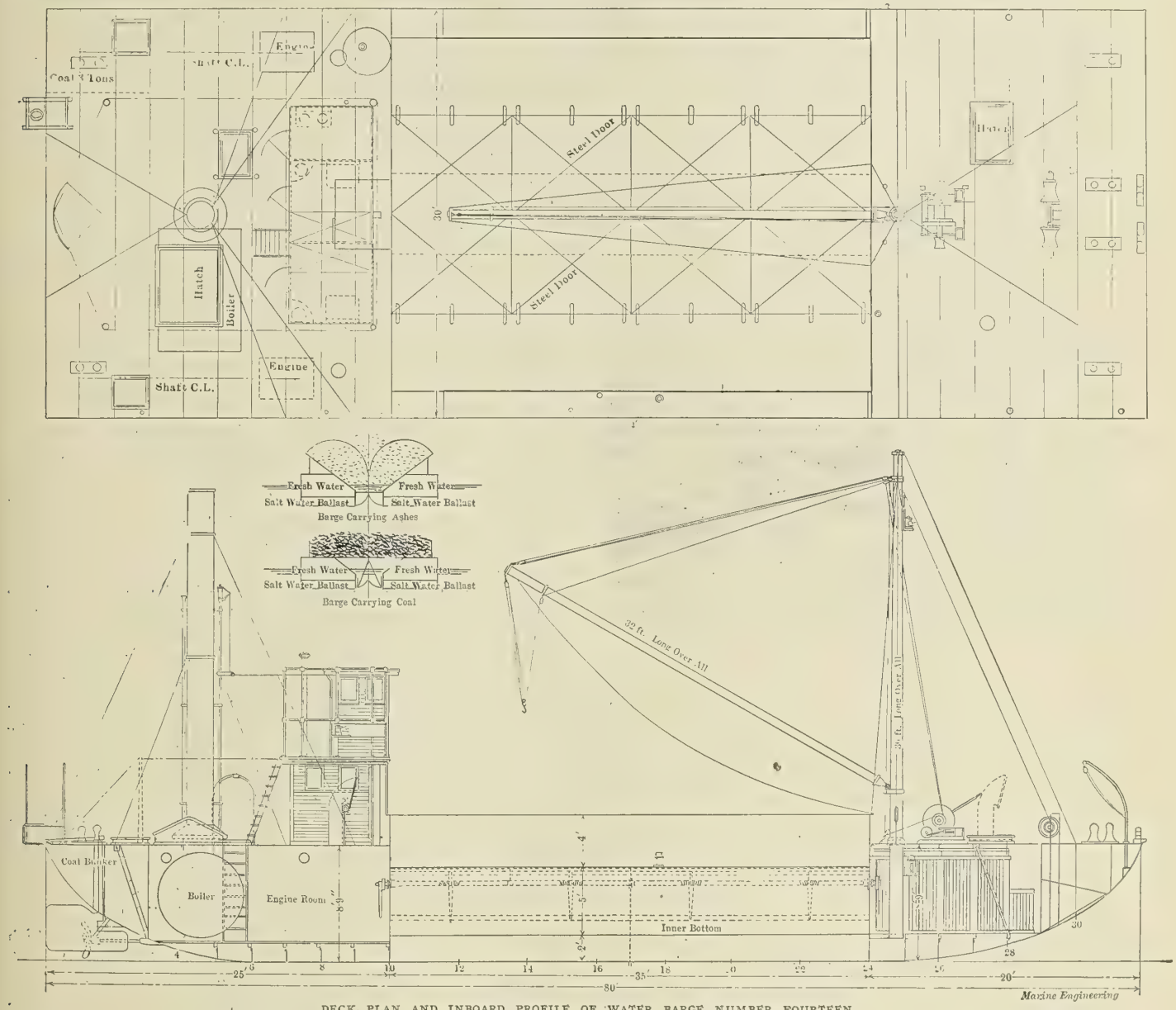
rather, the navy department—and it is practically certain that nothing will be done this year in the way of authorizing new warships. One additional battleship would have been provided for, in all probability, thus following out the recommendation of the President, but for the extraordinary indecision among the bureau chiefs since last March.

Chief Constructor Capps informed the naval committee recently that "tentative plans" were still being prepared, and that he believed that by July 1, 1906, the department would be ready to authorize the beginning of construction. One member of the committee is quoted as saying: "It will be useless for the naval committee to ask the House to appropriate money for another battleship, with absolutely nothing done toward building the two vessels authorized last March. We are trying to keep the facts about these two vessels quiet, so that we will not be embarrassed on the floor by being called upon to defend the inaction of the department."

Since the reorganization of the Bureau of Construction and Repair, just after the retirement of Admiral Hichborn, this bureau has undergone drastic changes created by the new school of naval constructors, who are now in complete charge. The civilians (commonly known as draftsmen) who served under the former bureau chiefs, have been disrated and detached from the bureau and their places filled by technical graduates of little or no practical experience. Among those whose services were dispensed with were the two leading draftsmen, who are mainly responsible for fine specimens of American warships such as the *Olympia, Oregon, Kearsarge, Wisconsin, Ohio, Pennsylvania*, the torpedo boat destroyers, and in fact practically all the vessels in our new navy. When these men requested the reason for such treatment, they were told it was due to "simply a change in methods."

It is unjust that men who have devoted their lives to the shipbuilding industry are tossed about by a corps of young naval officers, many of whom have had little or no experience in practical shipbuilding and designing. Such is the condition of affairs in the Bureau of Construction and Repair at the present time, and yet congress is amazed at the length of time for executing the plans for the two battleships appropriated for one year ago. Under the administrations of the former chief constructors (who were, by the way, appointed from civil life) no such conditions prevailed as are at present brought to our notice. Possibly we might say they were not hampered by such a thorough technical training. As all the shipyards are hungry for work, let us have the battleship plans at the very earliest date possible.

X-Ray.



DECK PLAN AND INBOARD PROFILE OF WATER BARGE NUMBER FOURTEEN.

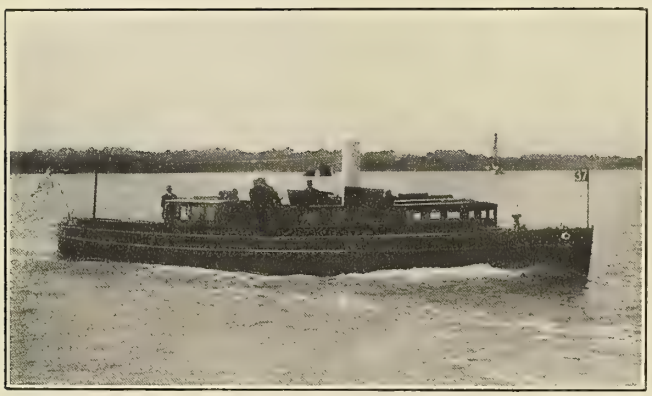
THE SUCTION PRODUCER-GAS YACHT EMIL CAPITAINE.

BY LEON RAMAKERS.

The gas engine, in conjunction with a suction gas producer, if properly designed, is the most economical generator of power (apart, of course, from natural sources), which the world has known. The hourly consumption of fuel with such a plant is as low as one pound of anthracite per brake horsepower. A good compound-condensing steam engine uses from two to five pounds per brake horsepower per hour, according to size and type. With the oil engine the consumption is approximately one pint (= one pound) of gasoline per brake horsepower per hour. Anthracite costs about $4.60 per ton, and gasoline about $30 for the same quantity. It will therefore be seen that the respective costs for fuel are:

For the oil engine 6.5
For the average good steam engine..... 3.5
For the producer-gas plant ..... 1.

Then, again, with the growing use of the spirit and the oil motor for small powers, it seems to be evident that in the course of time the world will not produce sufficient oil to keep pace with the demand; or, at least, the price of this fuel will so increase as to make the use of the engine employing it no longer sufficiently



THE YACHT EMIL CAPITAINE.

remunerative. The advantages, however, of the internal combustion motor for many purposes, and particularly for certain classes of marine work, are so obvious that it is desirable to retain it. These considerations lead us to see the great future there is for the suction gas-producer plant for marine work, provided it can be satisfactorily adapted to the conditions of service afloat.

A paper was recently read before the Institute of Naval Architects, by Mr. Thornycroft, upon the subject of gas motors, and shortly following this it was found that the principle had been very thoroughly thought out by Herr Emil Capitaine. Messrs. Thornycroft became intimately interested in the work which he was doing in this connection. As it appeared that his was an eminently practical and satisfactory system, Messrs. Thornycroft entered into an agreement with him to take over the sole British rights in his suction gas-producer plant (Messrs. William Beardmore & Company, Ltd., sharing with them the rights to manufacture the larger types), and they are now manufacturing this in certain sizes suitable for marine work.

In this connection it is interesting to note that the first recorded instance of a vessel being propelled by an internal combustion motor was the auxiliary yacht *Djezirèly,* belonging to the Marquis d'Nare d'Aubais, which, in the early "sixties," was fitted with a Lenoir engine. It is curious to note that this engine was of a heavy type, and used gas as its fuel, but in this case the gas was generated on shore and stored under pressure in cylinders or tanks aboard the vessel.

The introduction of the explosion motor using oil or spirit as fuel followed, and it is only in recent years that the importance of the self-contained gas-producer plant has been realized.

Herr Emil Capitaine has fitted several vessels with his gas engines and producers, with which he has achieved some quite remarkable results in sheltered waters on the continent, but the yacht which Messrs. Thornycroft have built and engined with plant constructed by them on the Capitaine system, and which they have entered for the Motor Yacht Club's reliability trials, is the first vessel of its kind to run in the open sea. This yacht, which out of compliment to the inventor of this system of propulsion has been christened *Emil Capitaine,* is built as a sea-going small motor yacht, and is fitted with permanent cabin accommodation.

The hull is of galvanized steel plate, and has a length of 60 feet, with a beam of 10 feet, and is designed on the Thornycroft principle, which has been adopted in many of their boats, whereby a broad flat stern is obtained, and the propeller works in a tunnel. This ensures great steadiness without causing the stern to settle down unduly when running in the water, and further a clear and unobstructed flow of water is maintained to the propeller. The yacht is provided with two saloons, one forward and one aft, both of which are handsomely lined throughout with polished teak. Lavatory conveniences are arranged off the after saloon. The boat is intended primarily as a day boat, but there would be no difficulty in arranging bunks in the forward saloon for sleeping accommodation. A neat hand winch is fitted right forward for manipulating the cable. In the after part of the boat is provided a steel-lined well, with automatic draining valves, suitable for carrying luggage or a motor car if desired.

The power for propulsion is derived from a suction producer-gas plant in conjunction with a specially-designed gas engine. These have been built by Messrs. Thornycroft from designs and on the principle invented by Herr Capitaine. The engine is of the vertical inclosed type, having four cylinders each 8¼ inches in diameter by 11 inches stroke, and running at 300 revolutions per minute it gives about 75 horsepower on the brake.

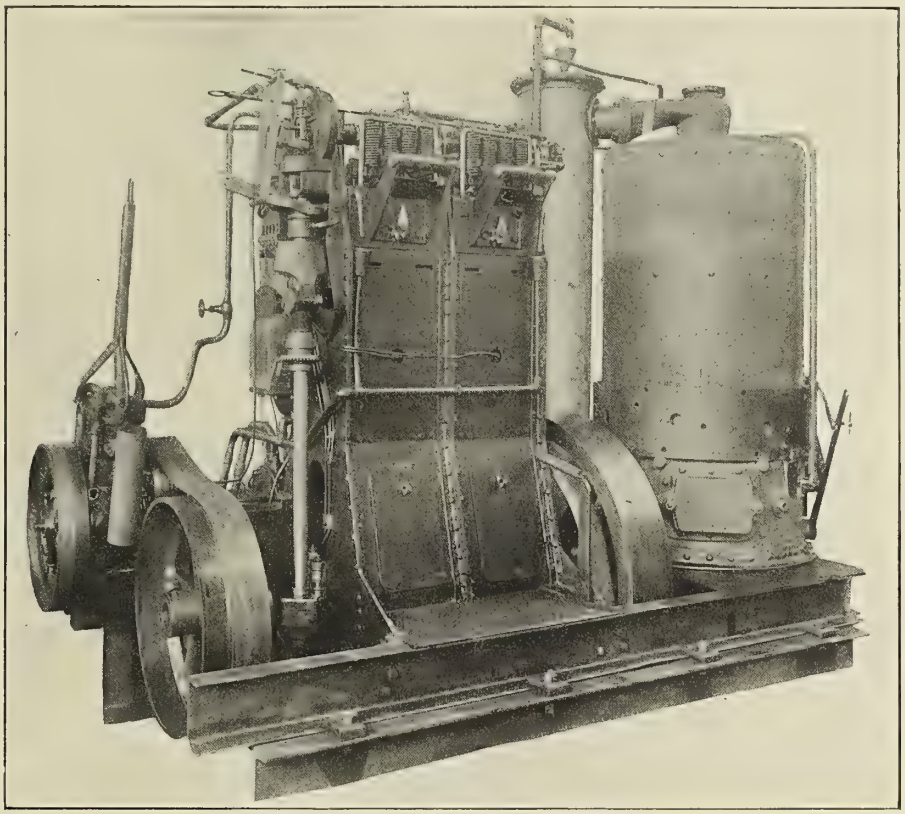
The inlet and exhaust valves are all mechanically operated, the cam shaft being placed above the top of the cylinders and slightly out of the center line, and the valves actuated by means of rocking levers. The cam shaft is hollow and carries in it a sliding shaft, which by means of radial arms projecting through slots in the cam shaft, operates the low-tension ignition strikers. The longitudinal motion of this inside shaft, which is controlled by the governor of the engine, varies the time of ignition, advancing it as the speed of the engine increases. Arrangement is provided whereby the timing of the magneto machine is simultaneously varied to correspond with the point of ignition. The engine itself is controlled by means of a throttle valve in the induction pipe connected by a special arrangement to the governor. There is besides provision for completely cutting out the electrical circuit when the speed of the engine exceeds a certain limit.

Half-compression gear is provided for starting the engine, which is done by a separate 6-horsepower Thornycroft motor through the medium of a belt. The half-compression cams are automatically thrown out of action by means of an attachment to the governor, when the engine is running at normal speed. A centrifugal pump, driven from the engine, is provided for supplying cooling water to the combustion heads and cylinder jackets. The exhaust is also water-jacketed, and the gases are discharged up a funnel, no muffler being required. A reciprocating pump of special design is provided for forcing oil in turn to all bearings.

Special provision is made to facilitate the cleaning of the cylinders, valves, etc., and a peculiar feature of the engine is that although the combustion heads are separate from the cylinder barrels yet the explosive strain on the combustion heads is taken not by the connecting bolts but by the whole framework of the engine. Doors are fitted in the lower part of the engine casing to provide access to bearings, etc. At the forward end of the crank shaft is

a pulley for driving a gas dryer, and a centrifugal pump for pumping the heated and dirty water from the gas purifier.

The gas producer is of the ordinary cylindrical shape. It is lined with fire brick and has three charging doors in the top, which deliver into a conical annular hopper. A fire grate and air



THE PRODUCER PLANT AND ENGINE.

and steam inlets are provided in the lower part, as usual. A special feature of the gas-producing plant is the arrangement for drying and purifying the gas without using any solid material in the scrubber, as is usual. The hopper of the producer carries enough anthracite for a ten hour's run at a speed of about 10 to 12 miles an hour.

The total floor space occupied by the engine and producer is 12 feet 6 inches by 9 feet 4 inches, and the height in each case is 6 feet 8 inches.

Editor's Note: We are informed by Emil Capitaine & Company, 25 Whitehall street, New York, who are looking after the American interests of the Capitaine gas engine and producer, that the coal consumed for a 10 horsepower engine amounts to about 1.1 pounds per indicated horsepower per hour. This figure is stated to be decreased with increasing powers of the engine, becoming 1 pound at 30 horsepower and about ⅞ pound at 50 horsepower. Of course these figures cannot be directly compared with those for a steam plant; because of the fact that the quality of coal used is necessarily more expensive. But even taking account of this fact, there seems to be a very decided economy in the coal bill.

An engine of 25 horsepower is said to occupy floor space of 32 by 75 inches and a height of 50 inches. For double this power the height is the same and the floor space is 32 by 103 inches, the weight for the larger engine being only about 25 percent greater than for the smaller size. These engines are built invariably in multiple cylinder form, the standard sizes at present being 25 horsepower 2 cylinder; 75, 150 and 300 horsepower 3 cylinder; 50, 100, 200 and 400 horsepower 4 cylinder.

An interesting test was made in November, 1904, between a tug fitted with this type of generator and engine and a steam-propelled tug of about the same size and power. The maximum pull recorded by a towing meter reached 2,190 pounds for the producer tug and 2,020 pounds for the other. On a ten hours' run at 8½ knots the producer tug consumed 530 pounds of anthracite, and the steam tug 1,820 pounds of steam coal.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of March 10, 1906, the following percentage of completion of vessels building for the United States Navy:

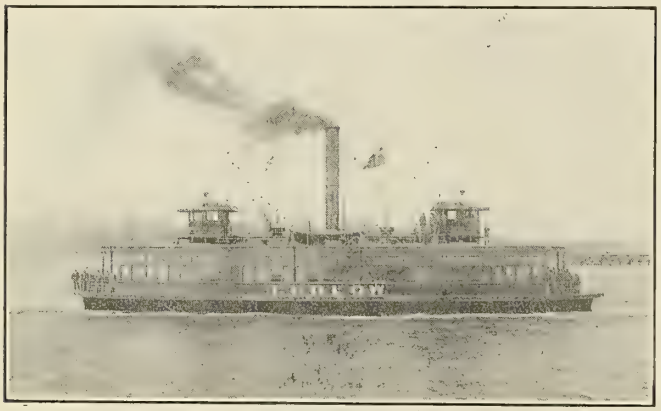
				Feb. 1.	Mar. 1.
BATTLESHIPS.					
Virginia	19	knots.	Newport News Co.	98.6	99.
Nebraska	19	"	Moran Brothers Co.	86 17	90.
Georgia	19	"	Bath Iron Works	93.35	94.59
New Jersey	19	"	Fore River Shipbuilding Co.	96.5	97.5
Connecticut	18	"	Navy Yard, New York, N. Y.	95.16	96.13
Louisiana	18	"	Newport News Co.	95.24	97.19
Vermont	18	"	Fore River Shipbuilding Co.	73.5	76.3
Kansas	18	"	New York Shipbuilding Co.	72.5	74.2
Minnesota	18	"	Newport News Co.	82.08	83 52
Mississippi	17	"	Wm. Cramp & Sons	49.08	51.21
Idaho	17	"	Wm. Cramp & Sons	47.19	49.18
New Hampshire	18	"	New York Shipbuilding Co.	37.1	39.3
ARMORED CRUISERS.					
California	22	knots.	Union Iron Works	88.7	90.
South Dakota	22	"	Union Iron Works	87.3	89.1
Tennessee	22	"	Wm. Cramp & Sons	94.53	94.53
Washington	22	"	New York Shipbuilding Co.	94.4	95.5
North Carolina	22	"	Newport News Co.	34.48	37.04
Montana	22	"	Newport News Co.	30.11	32.41
SEMI-ARMORED CRUISERS.					
St. Louis	22	knots.	Neafie & Levy C(	.34	90.56
Milwaukee	22	"	Union Iron Worl	.	90.9
SCOUT CRUISERS.					
Chester	24	knots.	Bath Iron Works	18.87	22.28
Birmingham	24	"	Fore River Shipbuilding Co.	21.	24.5
Salem	24	"	Fore River Shipbuilding Co.	21.1	24.9
SUBMARINE TORPEDO BOATS.					
Submarine No. 9			Fore River Shipbuilding Co.	51.	61.
" " 10			Fore River Shipbuilding Co.	43.3	48.9
" " 11			Fore River Shipbuilding Co.	43.5	50.9
" " 12			Fore River Shipbuilding Co	43.1	48.3

Electric Plant on the Ferryboat Ludlow.

BY FRANK C. PERKINS.

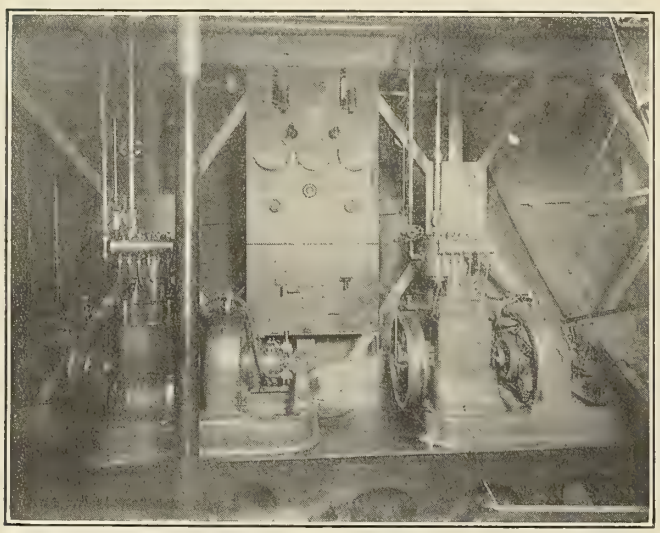
The accompanying illustrations show the electric installation on the *Ludlow,* which is in ferry service between St. Johns and Carleton, New Brunswick, as installed by Frank T. Vaughan, of the former city.

The engine room is equipped with two sets of engines and dynamos, constructed by the Canadian General Electric Company. Each of these units consists of a small engine directly coupled to an electrical generator of 4-K.W. capacity, at 110 volts pressure, and a speed of 600 revolutions per minute. The engines have cylinders 4½ inches in diameter with a 4-inch stroke, and are of the vertical high speed type, operating at a pressure of 80



THE FERRYBOAT LUDLOW.

pounds per square inch. These engines are said to be automatically governed, so that a variation in load of 25 percent will affect the speed of the engine no more than 2 percent. Each engine and dynamo is mounted on a single bed plate with a



ELECTRIC PLANT OF LUDLOW.

rigid connection between the shafts. The generators are used exclusively for incandescent lighting of the ferryboat, and are of the direct current, constant potential type, with compound winding. These multipolar machines are self-regulating, and fitted with automatic oiling devices, with oil reservoirs fitted with sight glasses. The efficiency of the electrical machines at normal load is said to be 80.5 percent, which is good for the small size of the machines. It is stated that they can operate for an indefinite period without heating either the bearings, armature or field coils, or commutators more than 70 degrees above the surrounding air, and can stand an overload of 25 percent for one hour without excessive heating. They are so compounded that the voltage will not exceed 115 or fall below 110 volts, between full load and no load.

The ash pits are constructed of 10½-pound plate and 2½ by 2½ inch by 5-pound angles, supported by angle stanchions from the floors; they are 5 inches deep and have one inch of cement coating on the bottom.

The feed pump is of the horizontal, simplex type with a steam cylinder 4½ inches in diameter and a water cylinder 2¾ inches in diameter, the stroke being 6 inches. This pump, and the fire pump, the air pump and the sanitary pump, were constructed by the George F. Blake Manufacturing Company. The fire pump has two 7½-inch steam cylinders and two 5-inch water cylinders, while the air pump is a 4 by 8 by 6 Blake vertical simplex featherweight pump, having composition air ends, with steam cylinder lagged with Russia iron and polished brass bands.

The lighting equipment of the *Ludlow* includes 112 lamps of 16 candle power, operating at 110 volts pressure. These lamps have an efficiency of 3.1 watts per candle power, and it is guaranteed that the candle power will not decrease more than 20 percent after burning 600 hours. The switchboard shown in the accompanying illustration is mounted between the two engines, and is made up of two panels of slate 1¼-inches thick, having two positive and one negative buss bars, together with the usual automatic circuit breakers, ammeters, voltmeters and controlling switches.

The New English Scout Cruiser Adventure.

The *Adventure*, the most recent English destroyer of destroyers, has lately completed her official trials, which were very satisfactory. The main dimensions of the vessel herewith illustrated are: Length, 374 feet; beam, 38 feet 3 inches; molded depth, 23 feet 3 inches; draught, 12 feet 6 inches; displacement, 2,620 tons; coefficient of fineness, 0.51. The main engines, which in this class of vessel have to be heavier than is usual in destroyers, are of the Marshall-Allen patent six-cylinder type, designed for 16,000 horsepower at 250 revolutions. The aim of the design is, by adopting small cylinders with comparatively short strokes, to decrease weight and height, to decrease strains due to moving weights, and to give equable torque, all without increasing the piston speed.

The twelve boilers of the *Adventure* are of the latest Yarrow type, in which all the incoming feed is caused to traverse the outer rows of tubes before mixing with the evaporating water. Experience has proved the advantage of this arrangement. The total grate area is 784 square feet; heating surface, 42,686 square feet; ratio, 54.4 to 1; the two rows of tubes on either side nearest the fire are slightly curved; their diameter is 1⅜ inches, that of the remainder, 1⅛ inches. There are three fire rooms, with four funnels; each fire room has two vertical double-breasted fans, driven by vertical closed engines with forced lubrication. Area for air inlet, about one-seventh of grate area; full speed periphery velocity of fans, about 97 knots. The brickwork of the boiler is fitted independent of the boiler casing, and air is admitted through a number of the hottest bricks above the fuel. Wing passages are provided to the boiler rooms, enabling better supervision and speedy attendance of the officer on watch when necessary; a system which is clearly preferable to that of climbing along over the hot tops of the boilers and diving at intervals.

The bunker capacity is 450 tons, the vessel doing ten nautical miles per ton of coal at 10 knots. The storage space is divided into upper and lower bunkers, there being eight of the former on each side, giving excellent protection to both boilers and engines, and three of the latter abreast the fire rooms, thus twenty-two bunkers in all.

Each engine has one surface condenser having tubes 10 feet long, with double flow of circulating water, which enters at the

after ends of the lower tubes. The cooling surface in each condenser is 6,800 square feet. The main engines have ample rubbing surfaces, there being eight long and two short bearings for each crank shaft. The connecting rods have their pins shrunk in and secured. The high-pressure rods have no soft packing; the remainder have the closed type with soft packing outside. These glands worked well, the records showing that the loss of water from all wastes was only 7.6 tons on the eight hours' full speed trial, this being largely due to the safety valves lifting. The loss from all sources, including safety valves, syrens, gauge cocks, leaks and drains, was less than one-third the amount permitted by the Admiralty rule for loss of water, which is one gallon per horsepower per day. Each boiler has an automatic feed regulator. The auxiliary feed pumps are capable of feeding for full power, and were tested to prove this for three hours during the full-speed trial.

The means for adjustment of main bearings and connecting rods is very efficient. Graduations on the fixed parts are marked, and the nuts can be turned and locked so as to give each adjustment 1-144 inch of tightening or slackening of brass. It is impossible for the nuts to slacken, having first to shear two cotters. The arrangement is snug, and obviates the sometimes experienced accident in which the greaser, fond of wearing finger rings, has found a small split pin seize his ring, and so cut his finger to the bone.

The highest speed obtained during the trials was 25.955 knots, and there were indications that 26 knots could be maintained. The other results were: Number of revolutions per minute, 251.6; indicated horsepower, 15,850. E. O.

THE ENGLISH SCOUT CRUISER ADVENTURE ON TRIAL TRIP.

British Naval Scouts.

Great interest has been taken in the production of the new class of scouts recently ordered by the British Admiralty. H. M. S. *Forward*, the first of two built by the Fairfield Shipbuilding Company, Glasgow, has completed her official steam trials. She realized, as a result of six runs over the measured mile at Skelmorlie, on the Clyde, a mean speed of 25.286 knots when developing 14,995 indicated horsepower. The guarantee on contract was a speed of 25 knots. The increase is a quarter of a mile in excess of the guarantee, with 1,500 horsepower less than that stipulated. This proves that the form of the hull is exceptionally satisfactory, and that the machinery is of high efficiency.

The *Forward*, and her sister ship, the *Foresight*, belong to a new class in the British navy, the first two of eight ordered and intended for scouting duty. Speed is the dominant consideration, and a radius of action at 11 knots of 5,000 miles has been realized. These vessels have only ten 12-pounder and eight 6-pounder guns, with two tubes on deck for firing 18-inch Whitehead torpedoes, to enable them to deal with torpedo-boat destroyers. Their principal function is to bring news, and therefore speed is the first object. Their length between perpendiculars is 365 feet, beam 38 feet 9 inches, and they displace 2,850 tons on a draft of 14 feet 2 inches, with 150 tons of coal in the bunkers, sufficient to carry them 1,500 nautical miles at 10 knots. There is bunker capacity for 500 tons of coal, to give a radius of action of 5,000 nautical miles at the same speed. The speed of 25 knots involves a high rate of combustion in 12 boilers of the modified Thornycroft type, but on the official full-power trial the air pressure in the stoke-hold was under 2 inches. The boilers working under easy conditions supplied adequate steam for the engines, which are of the four-cylinder, triple-compound type, driving twin screws.

A 96-hour coal consumption trial at the most economical speed was made. On four successive days the vessel returned to the measured mile at Skelmorlie to ascertain the speed for the mean revolutions made by the engines during each 24 hours. At the end of this 96 hours' trial it was found that the power for 10.66 knots was 829, and that the average rate of fuel consumption was 2.66 pounds per indicated horsepower per hour. Other trials were made at various speeds, which indicated that a 25-knot speed can be realized with a considerable margin of power. The *Forward*, loaded to her full draft, then had her full-speed tests. Two preliminary runs were made over the measured mile at 23 and 24 knots while working up speed, and the official eight-hour test commenced with six runs over the measured course. The engines were linked up a bit as there was no need for a full effort to meet the requirements. The first run over the mile, with the tide, was made in 2 minutes 20⅘ seconds, equal to a speed of 25.568 knots. On the return run the tide made a difference of 1⅘ seconds, while the third run, again with the tide, occupied ⅗ second more than the first run. The ship continued to and fro for six runs in all, the variation between the longest and shortest times being 2 seconds. Analysis of the runs showed that the mean speed of all six runs was 25.286 knots, the horsepower of the engines averaging as above 14,995 for a mean of 211 revolutions per minute.

After completing the six runs, the *Forward* continued on an eight-hours' course, the engines maintaining about the same number of revolutions. She headed down the estuary, and then steamed up Kilbrannan Sound, and finished the circumnavigation of Arran in a very short period. When the eight-hours' trial terminated, a variety of maneuvering tests were undertaken at full power, and the trials going astern with three-fourths of the engine power were interesting as indicating possibilities of the cruiser escaping from tight corners. The summation of the results taken each hour showed that the revolutions averaged 210 per minute, and that the mean horsepower was 15,022. The air pressure in the stoke-hold was 1.8 inches; the average steam pressure at the boilers 250 pounds, and at the engines 230 pounds. The vacuum was 25 inches over the whole eight hours, and the speed was quite 25¼ knots, though the ship had not been in dock for two months previous to the trial. Benj. Taylor.

MOTOR BOATS, X.

BY DR. WILLIAM F. DURAND.

PRACTICAL BOAT CONSTRUCTION.

Within the limits of the present series of articles it will be quite impracticable to undertake any comprehensive discussion of the art of boat building. Brief consideration may, however, be given to the general principles which underlie the work of the boat builder, and to the general methods whereby those principles are carried into practical effect.

The fundamental purposes of the boat builder are two in number:

(1) The realization of the desired form.

(2) The provision of the necessary strength.

The principles and practice of boat building, therefore, circle about these two things, *form* and *strength*. The first has reference

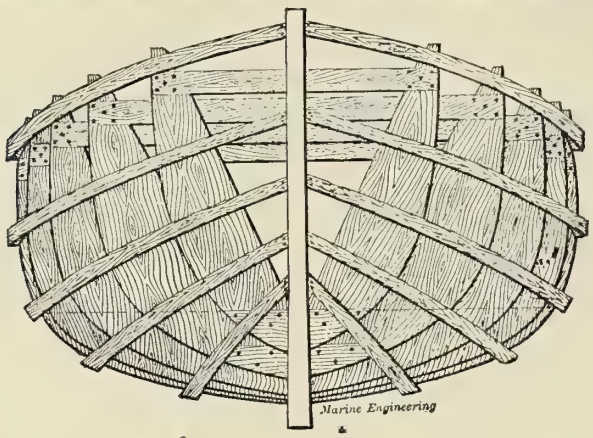


FIG. 48. BOAT SET UP WITH MOLDS.

to geometry and the second to mechanics. Many other secondary purposes must, of course, receive due attention; such as those having relation to matters of convenience or comfort, and dependent primarily on personal taste. These are, however, of only collateral importance or interest, and we may therefore confine our attention to the principles which are involved in the attainment of the two main purposes— the realization of form and the provision of strength.

The first point to be made clear is that while the main purposes are thus stated under two heads, it by no means follows that two sets of structural members are to be provided, one set having special reference to form and the other to strength. Quite on the contrary, the skill of the boat builder is largely expended in devising ways and means for attaining most effectively both purposes by the same set of structural members, or in any event in avoiding as far as possible the use of members which relate to one of these purposes alone. The boat builder's ideal in such matters is naturally a structure in which both the determination of form and the provision of strength shall be provided by substantially the same sets of structural members.

Turning now to the question of form, it is clear that the actual form of the surface of the boat will be determined by the outer skin or planking. But planking alone cannot be assembled in the proper form without something over which it may be bent or formed as desired; and even when so bent the planks would scarcely retain permanently their form without an internal

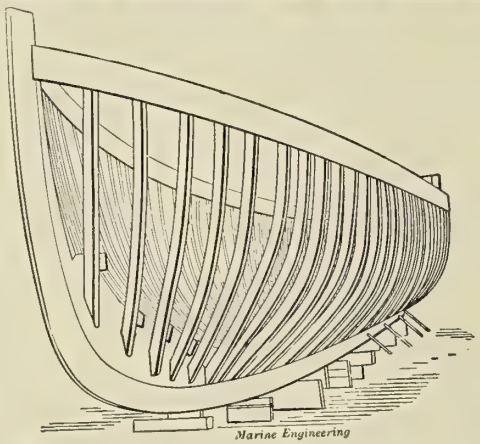


FIG. 49. BOAT IN FRAME, READY FOR PLANKING.

framework or stiffening which shall be permanent in form by itself, or rather which with the planking shall make a combination permanent in form under the conditions of service intended. The fundamental feature in the realization of form is therefore the planking. In fact the planking is in a sense the essence of the boat—all else is auxiliary or secondary—and to realize the planking two things are necessary:

(1) Frames or forms of some kind over which the planking may be bent and secured in shape.

(2) Some permanent internal stiffening or frame work which shall serve to assist the planking in maintaining the form given to it.

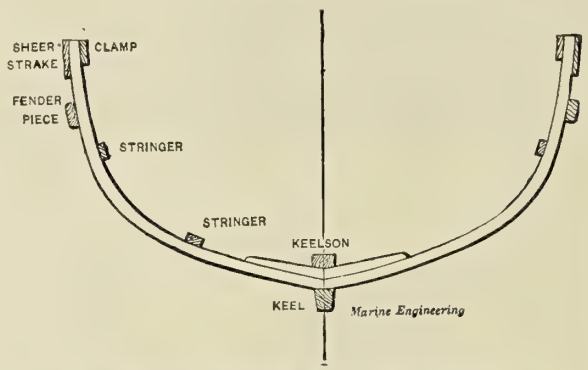


FIG. 50. MIDSHIP SECTION, SHOWING LONGITUDINALS.

At this point we find two different practical methods of boat construction. In one which is quite commonly employed in building canoes, rowboats and quite small motor boats and launches, the forms over which the planking is bent are simply wooden molds put in place temporarily, their sole purpose being to bring the planking to the proper form for the outer surface of the boat. In the second type, which is always used for larger boats, the internal framework, consisting of frames and cross ties or deck beams, is formed and erected in place first, and the form of the boat is thus determined in skeleton. The planking is then bent over the frames and secured to them, and is thus brought to the form desired. In this case, therefore, the forms over which the planking is bent constitute a permanent part of the structure. Fig. 48 shows a boat set up with molds and the form thus determined, and illustrates the distinctive step in this mode of construction. Fig. 49, on the other hand,

shows a boat in frame, with the form determined in skeleton, and thus illustrates the distinctive feature of the other mode of construction.

We must now turn to a consideration of strength, which we may conveniently examine under three heads:

(1) Longitudinal strength.
(2) Transverse strength.
(3) Local strength.

By longitudinal strength we mean the capacity to resist bending of the boat as a whole, or any general distortion in the fore and aft lines.

By transverse strength we mean the capacity to resist such distortion as would produce a change of form in the transverse sections, or in their relation to each other, as by a gradual twist about a fore and aft axis.

By local strength we mean the capacity to resist local stresses of such a character as may tend to pierce or tear the hull at some particular point, but which may not necessarily tend to produce any general distortion or change of form in the boat as a whole.

With reference to longitudinal strength, the boat must be treated as a beam or girder, and must contain longitudinal members so disposed as to give the needed strength and stiffness in this direction. To this end the planking naturally contributes very largely, and as a rule only certain supplementary members are required, chiefly near the top and bottom of the boat, considered as a girder. For such purposes some combination of keel, keelson, sheer strakes, deck and side stringers, clamps and fender pieces may be fitted. These various members are illustrated in Fig. 50. Only rarely would they all be fitted in one design. In Fig. 51 is also shown the arrangement adopted in a case of actual design, and illustrates good practice with reference to these details. In Figs. 52 and 53 are likewise shown sections of a boat of the extreme high speed type, the former about amidships showing the engine under a turtle back, and the latter aft near the rudder showing the stern nearly resting on the surface of the water. See also Figs. 33 and 35.

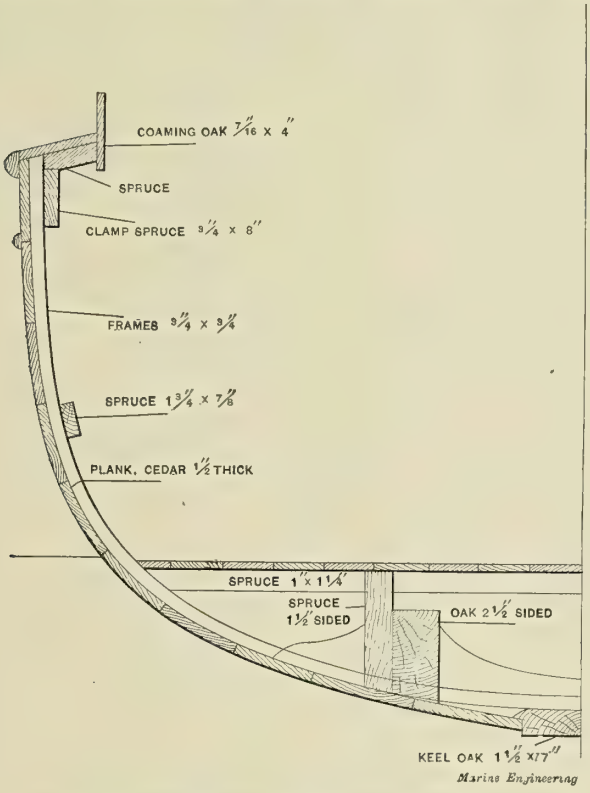

COAMING OAK 7/16 X 4"
SPRUCE
CLAMP SPRUCE 3/4 X 8"
FRAMES 3/4 X 3/4
SPRUCE 1 3/4 X 7/8
PLANK, CEDAR 1/2 THICK
SPRUCE 1" X 1 1/4"
SPRUCE 1 1/2" SIDED
OAK 2 1/2" SIDED
KEEL OAK 1 1/2" X 17"
Marine Engineering

FIG. 51. MIDSHIP SECTION OF 35-FOOT SPEED LAUNCH.

Turning now to the question of transverse strength, we find that the planking, together with the internal framing over which it is fitted, provide together the primary or chief item of strength in this direction. These parts in particular, therefore, represent the double use of structural members—for the determination of form and for the provision of strength. It is clear that the spring of the frame and that of the planking will naturally oppose each other, and that out of this equilibrium under opposite forces there will arise a degree of strength with regard to transverse distortion. The weak part of such a structure as illustrated by an absolutely empty shell made up of planking and frames will clearly be at or near the gunwale, where the equilibrium of planking and frames would be difficult to secure or to maintain, and in consequence of which the sides would tend either to open out or to collapse, thus in either case changing the effective beam of the boat. To remedy this defect, deck beams, serving either as struts or as ties, as may be needed, are fitted except in the way of cockpits or other deck openings. Here deck stringers as shown in Figs. 51 and 52 are fitted, thus supplying at these points the needed special strength against transverse distortion. The laying of the deck planking on the deck beams adds also its quota of transverse strength against compresssive stress, though the primary purpose of the planking must be put down as shelter or convenience rather than as transverse strength.

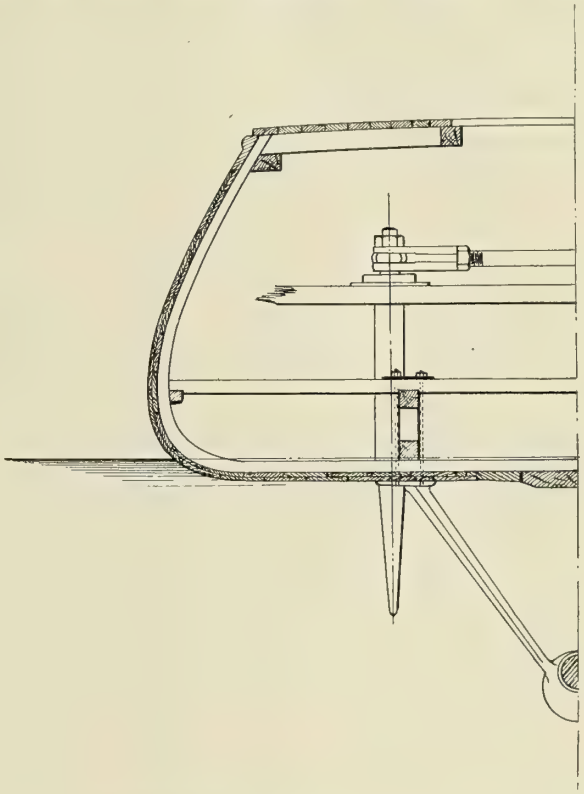


FIG. 52. SECTION OF VERITAS IN WAY OF RUDDER.

So far furthermore as the deck planking is continuous fore and aft, it adds an important item to the schedule of members furnishing longitudinal strength, and its possible function in this direction should therefore not be overlooked.

The function of the floor as an item of transverse strength should also be noted. The floor is a transverse vertical board or piece of thin planking, secured to the bottom of the frame and extending from side to side across the keel. In the way of cockpits the upper edges of a series of such floors are lined up so as to form the foundation for the bottom of the pit or opening. The function of the floor is to tie across and consolidate the frames, skin planking and keel at the bottom of the boat, and thus

to give strength and stiffness along the keel with reference to transverse or twisting distortion, and to furnish an element of support at the keel, considered as a joint about which the two sides of the boat may tend to work when subjected to transverse forces.

Coming next to the question of local strength, it is naturally found to result that except at special points the needed local stiffness and strength may readily be provided by the members intended for general strength in the transverse and longitudinal directions. Hence for the construction in general no special provisions are required for local strength, and it is only at special points, such as about the stem and fore-foot along the side where contact with a dock may be likely, under the engine, about the propeller shaft supports, as in Fig. 53, etc., that structural members specially intended for local strength are introduced.

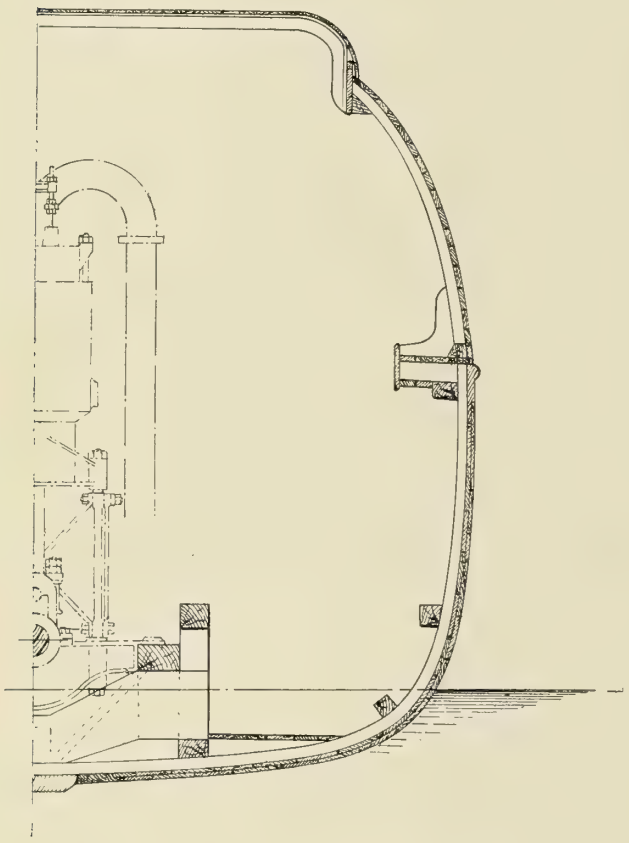


FIG. 53. SECTION OF VERITAS ABOUT AMIDSHIPS.

Local strength at the bow and at occasional other points in the framing is secured by filling in with chock, angle or knee pieces as shown by the cuts of longitudinal sections. Local strength along the side may be secured by a special fender or rubbing strip as shown in Fig. 50. Local strength under the engine is secured by a special foundation formed usually of longitudinal timbers or of structural steel which are intended to connect with the structure of the boat, and so lead away gradually into the structure of the boat as a whole the local stresses developed at the engine—see Fig. 51. A particular caution may be given here to avoid making such special foundation too short or too localized in character. It should be remembered that the real support of the engine is the boat, and that the object of the foundation is to give local strength and to bring to the support of the stresses developed, the maximum amount of actual boat structure.

(TO BE CONTINUED.)

A LITTLE STORY.

BY ADAM NED PHULE.

The manager of Ball & Ball sat before his roller top desk in a nice, comfortable, leather-back chair, reading his morning mail. Letter after letter was deposited in its proper basket for distribution, but one was laid aside and taken up when the distribution was finally made, and it read as follows:

Dear Sirs:—The somewhat delayed engines on your valued order, No. 167,283, are now ready for inspection and test. According to our contract, dated June 8, of last year, you agreed to have your inspector here at once on notification, and it is imperative that you comply with this part of the agreement to avoid further delay on account of penalties. Anticipating your prompt action, we are, Yours very truly, Henks & Henks Co.

The manager touched the bell.

"Mr. Mason, you just send Jenks, of the constructing department, to-day, without fail, to Henks & Henks to inspect the engines on our order No. 167,283."

"Send Jenks! Why he must go to ——."

"Now Mr. Mason my directions must be complied with. You will please make out an expense warrant at once, and I will sign it, and Jenks must get off before night."

"Well, if you say so he must go, but job No. 169,440 is most urgently needed."

"Yes, yes, I know that, but on his return he can take that up, or perhaps you can send Sawyer."

"He is at Berry's with no end of trouble on his hands."

Two days later Jenks was in the shops of Henks & Henks, and for several days he was hard at it, and the engines were started and ran nicely.

"Hello, Jenks! When did you get out here?" This was the greeting from Martin, the inspector of engines for the motive power department of Ball & Ball.

"Why, three days ago. When did you leave the office?"

"I got my expense warrant and was told to 'fly.' I am to inspect the engines for my department on job No. 167,283."

The following morning a letter from the manager to Jenks read in part as follows: "Howard, our new inspector of erection, will arrive at Henks & Henks on the 10th. He is quite young, but a very good man, and I have given him a letter to you, as he is to inspect the engines for his department on job 167,283. Get through with your work as soon as you can and report at the office."

Howard soon appeared and went at his work with all the ardor of youth. He made no end of trouble, and was voted a nuisance by the shop hands. At the end of the week the inspectors had completed their work and were on their way back, seated in the sleeping car. Howard was silent and absorbed. He kept figuring away on a pad until bed time. On account of his youth the manager of Ball & Ball did not impress him with as much awe as he did Jenks for instance, or Martin. These two had written up their reports and handed them in to the manager before Howard had turned up. The manager was looking extremely stern as he noted his appearance.

"You are late, Mr. Howard. Have you the report?"

"Yes, and it is made out at length, and everything is passed and all right, but I want to call your attention to the last page of the report. You will notice that I have made out a little table showing the cost of the inspection by Jenks and Martin and myself on the engines for our various departments on job No. 167,283. It amount to $162.00, not counting salaries at all, which is just three times as much as it should cost. The three of us went 200 odd miles to make an inspection of engines which any one of us was perfectly capable to make, at just one-third the actual expense, and very little if any time was saved. Now——."

"Mr. Howard, I make allowances for your being young, but the management of this concern is in the hands of men brought up in it, and the idea of one man inspecting for various departments is not one of its traditions."

"But, Mr. Manager, I am a stockholder in this concern, and

here is a waste of money which could be avoided. I inspect engines for the erection department, Jenks for the construction department and Martin for the motive department. If any one of us is qualified to inspect an engine for one department, he is certainly qualified to do it for another. No better results can be obtained from three of us doing this work than from one. Why not make an inspection department which will look after all materials and apparatus of the same nature?"

"Young man, you propose something which would not work at all. Remember that the directors of this company must be consulted. They have friends who like to have their friends at the head of departments, and they do not like to have any encroachment on their domain."

"But, Mr. Manager, it seems to me that this inspection business is all wrong. I worked like a dog for a year to find out about ropes. I got the whole subject down fine and knew all about the makers, and was thoroughly practical on the subject; then you turned me over to inspecting engines, and now Wallace is looking after rope, and passing stuff that is not fit to hang a dog with."

"Now Mr. Howard, I say again that I make good allowance for your youth, yet what you propose is utterly impracticable on account of tradition and cannot be considered by me. I must take up my letters now, good-bye."

"But, Mr. Manager, I am a stockholder."

"Good-day, Mr. Howard."

For Erection read Bureau of Steam Engineering.
" Motive Power " " " " Construction and Repair.
" Construction " " " " Equipment.
" Stockholders " " Taxpayer; and see how the thing fits.

The Steam Dredger Vulcan.

BY EMILE GUARINI.

The *Vulcan,* one of the most powerful center-ladder, barge-loading dredgers ever built, was recently constructed in the yard of Messrs. Ferguson Brothers, at Port Glasgow, for the construction of new docks and the deepening of some of the older docks on the Liverpool estate of the Mersey Docks and Harbor Board, which involves a vast amount of dredging of sandstone, rock and clay. This vessel was launched complete, with steam up, ready to start work, propelled and worked by twinscrew engines. Her length is 207 feet; breadth molded, 42 feet; depth molded, 14 feet.

She has a dredging capacity of 1,000 tons per hour from a depth of 56 feet below water level. The main engines, which are employed for either propelling the vessel or driving the dredging gear, consist of two sets of triple-expansion surface condensing inverted direct-acting type, having three cranks, and are capable of indicating 1,250 horsepower. They are fitted with steam reversing gear, and have auxiliaries embodying all the latest improvements. Steam is supplied from two cylindrical return multitubular boilers, constructed under Lloyd's special survey. The compartments at the after end of the ladder well are arranged as coal bunkers and feed tanks, having capacities of 100 and 50 tons respectively. The dredger thus engined is capable of propelling herself at a speed of 8½ knots. Steam steering gear, of the Harrison type, is fitted at the after end of engine casing, and is controlled from wheel house, which is placed on the highest point of dredger, at the top of the main gear framing.

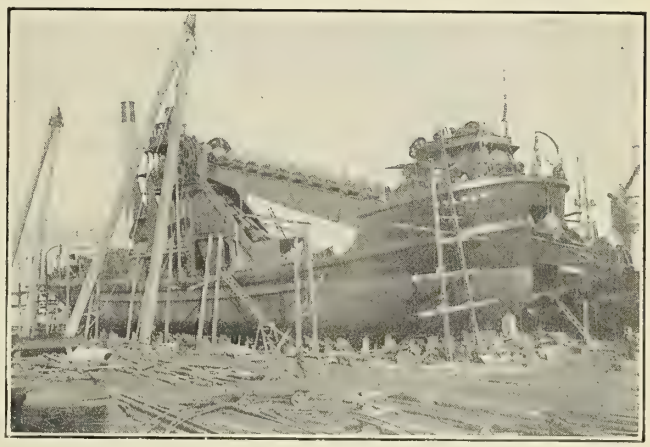
A complete installation of electric light is fitted throughout, large arc lamps being placed on deck for night work. Heavy elm beltings are fitted all round the vessel, also strong vertical fenders at intervals to take the wear of the barges lying alongside.

Separate accommodation is provided under deck for captain, engineers, crew and ladder men, all of which is roomy and thoroughly comfortable, special provision being made for light and ventilation.

Powerful steam winches are fitted at bow and stern of the vessel for manipulating the mooring chains and holding the dredger up to its work. Each winch is driven by an independent two-cylinder vertical engine. The forward winch is fitted in two sections, one in each side of the bow of the dredger, connected by shafting carried across the ladder well. The forward winch has four chain barrels with two rope warping drums. All chain barrels are provided with independent friction clutches and brakes, and can be worked separately or together, as required.

The dredging machinery is of massive design for working in the hardest materials that can be dealt with by bucket dredgers. The gearing is arranged to work the buckets at two different speeds, according to the nature of the material being dredged. All wheels, pinions, clutches, tumblers and bucket backs are of cast steel, the fast running wheels having helical teeth. The dredger buckets and links are of a specially strong design for working in hard material, each bucket having a capacity of 21 cubic feet, the connecting pins for the bucket chain being of manganese steel. The bucket ladder is suspended independently of the upper tumbler shaft.

The latter shaft is driven by double-friction spur wheels of large diameter, and capable of being adjusted to convey the necessary power to the buckets, according to the hardness of the material being worked. The hoisting gear for the bucket ladder consists of a heavy wire rope tackle, working in upper and lower sheave blocks, suspended from a crosshead fixed on a box-framing structure, built into the forward end of vessel.



THE DREDGE VULCAN BEFORE LAUNCHING.

The lower sheave blocks are connected to the bucket ladder by strong side rods. The wire rope is wound on a large grooved barrel, driven by gearing from a double-cylinder vertical engine, all placed under deck. The gearing between engine and barrel is of the "sun-and-planets" motion type, controlled by double friction brakes actuated by a compound lever for holding, heaving, or lowering the load as desired, the engine being free to run either with or without the load. The wheels and handles for working this gear are placed on deck under the control of the dredging master. A large steam derrick crane is fitted on deck for overhauling the buckets and links and for general purposes.

The bucket ladder projects in advance of the hull a distance sufficient to enable the vessel to dredge close up to the dock and quay walls, when buckets are lowered to a depth of 48 feet. She is capable of cutting her own flotation, and of dredging in any depth from her flotation level down to 56 feet.

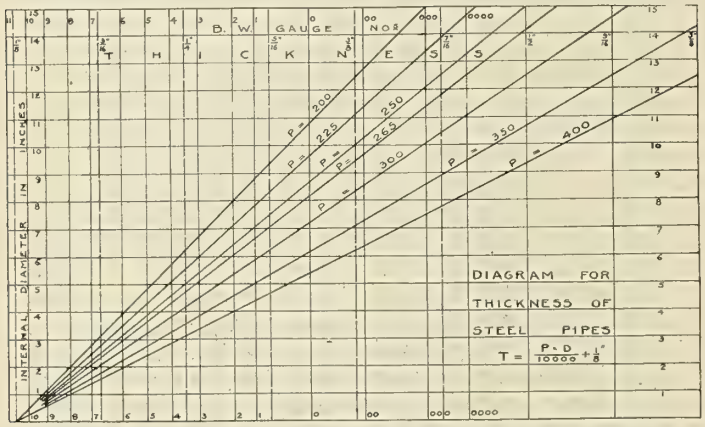
The hull is sub-divided into fourteen watertight compartments; the two sides of the hull forming the bow well at the forward end of the vessel, where bucket ladder projects, being strongly connected by a raised forecastle, constructed with heavy girder beams and strong bracing plates carried across above the ladder well. This forecastle is of a height to permit of the bucket ladder being raised for overhauling the lower tumbler, and to ensure the sag of the chain of buckets being above the bottom of the vessel. The bucket ladder and box framings for supporting

the chain of buckets and dredging gear have been constructed of the best class of girder work, all put together and efficiently connected with steel rivets closed by hydraulic pressure. Side chutes are arranged for discharging the dredged material over either side of the vessel into hopper barges, the lifting and lowering of each chute being worked by an independent engine. The regulation of the spoil to either side of the vessel is controlled by a strong flap door, fixed at the apex of the chutes, and is worked by gear from main deck.

The *Vulcan* went on trial four days after being consigned to the water. After adjusting compasses, she carried out her speed trials at Skelmorlie, attaining a mean speed of 8½ knots, this being half a knot in excess of that contracted for. She was constructed under the direction of Mr. Anthony G. Lyster, engineer-in-chief for the Mersey Docks and Harbor Board.

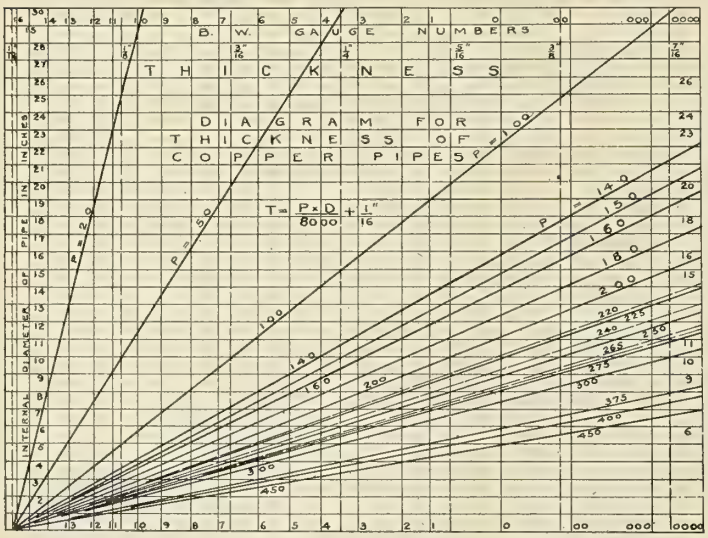
Standard Pipe Thicknesses.

Among the numerous standard specifications used by the United States Navy Department, two quite important ones deal with the



thickness of pipe. The first of these which we illustrate by diagram, gives the thickness in both Birmingham wire gauge and fractions of an inch for steel pipes of various sizes up to 15 inches in diameter, and with pressures varying from 200 pounds per square inch to 400 pounds. The thickness is calculated from the formula $T = \frac{P \times D}{10{,}000} + \frac{1}{8}$ inch.

The other illustration deals with the thickness of copper pipes of an internal diameter up to 30 inches, and gives the thickness of the pipe in B. W. gauge and fractions of an inch for pressures

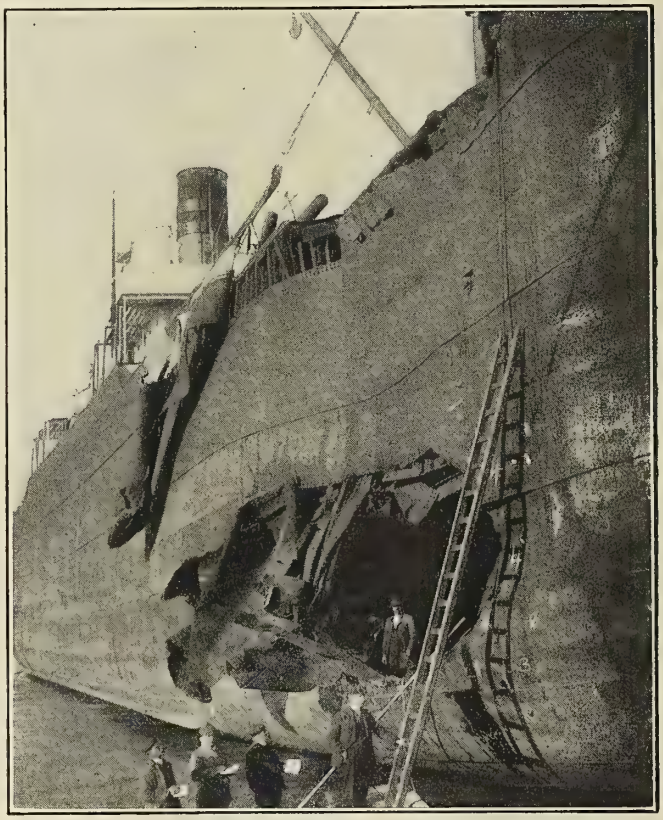


varying from 20 pounds per square inch to 450. The formula on which this calculation has been made is $T = \frac{P \times D}{8{,}000} + \frac{1}{16}$ inch.

A SERIOUS COLLISION.

The Norwegian steamer *Tordenskjold,* Captain Kroger, which was damaged in a collision with the Hamburg-American steamer *Euphemia,* October 23, at St. Antoine, some 40 miles above Quebec, was placed on Davie's dock, at Quebec, for temporary repairs. She is a vessel of 335 feet in length and was drawing, at the time of the accident, 23 feet 6 inches. She was on her passage from Sydney, C. B., to Montreal with a cargo of 6,000 tons of coal for the Dominion Coal Company.

The damages sustained by the *Tordenskjold,* as can be seen by the accompanying photograph, are very considerable. Besides



THE TORDENSKJOLD, SHOWING DAMAGE DUE TO COLLISION.

a large hole on her starboard side, where her plates have been twisted in, all her bulwark is badly torn or dented for a length of about thirty feet from her stem, and all her fore-parts on the starboard side are seriously pounded. In fact, the whole structure of the vessel has sustained considerable shaking up and will require a thorough overhauling.

She will be temporarily repaired and patched up with canvas, lumber and cement at Davie's docks, so as to allow her to take sea light, and it is understood that she will be taken to New York for permanent repairs. She may be called a total constructive loss.

A Canadian Fishery Cruiser.

BY J. O. WHITTEMORE.

The latest addition to King Edward's permanent fleet on this side of the water is the Canadian fishery protective cruiser *Canada,* which has recently arrived on her station. This craft is of more than passing interest, as she was designed and built for the special service of a fish patrol on the Dominion coasts. The craft is similar in type to the United States revenue cutters of the *Gresham, Algonquin,* and *Onondaga* class. She was launched about one year ago from Vickers Sons & Maxim's yard at Barrow, England, under the supervision of Chief Engineer D. M. Mooney, who has been acting chief of the *Canada* since she was commissioned.

The *Canada* is 210 feet long, 25 feet beam, and 14 feet deep.

She is built of mild steel, has a ram bow, and two decks. She is driven by two triple-expansion engines, with cylinders 15, 23½ and 38 inches in diameter, and a 24-inch stroke, at a working pressure of 180 pounds. She has two Scotch boilers under Howden's system of forced draft, and can develop 1,600 indicated horsepower with a speed better than 17

CANADIAN FISHERY CRUISER CANADA.

knots. Her auxiliary equipment is most complete. She has all the pumps usually found on the largest cruisers—See's ash ejectors, feed-water filters, evaporators, etc. The officers' mess rooms, cabins, pantry, bathrooms, etc., are on the lower deck aft. The captain's cabin is on the main deck in a deck house. The crew bunk forward on both decks. She has a full electric plant and a 25,000 candle-power searchlight on the bridge, which can pick up a poacher two miles off. Her armament consists of four quick-firing Maxims and two six-pounders. In her armory is a complete outfit of cutlasses, rifles, and revolvers, for her full complement of 60 men.

The *Canada* is rigged as a fore-and-aft schooner with pole masts. She has both hand- and steam-steering gear on deck and bridge. To chase smugglers in shore she has a large and fast steam launch, and four other boats. She is fitted with the submarine signal system, also with wireless telegraphy. The new boat, with her speed, searchlight, and other special equipments, is most admirably adapted to the purpose of policing the fishing grounds, and her coming adds greatly to the risk of illegal fishing.

Stranding of the Steamship Virginian.

Early in the fall of 1905 the large steamship *Virginian* of the Leyland Line ran ashore in the St. Lawrence river just above Quebec, while on her way to Montreal. The difficulty was due to very thick weather caused by heavy forest fires in the vicinity, which made it impossible for the pilot to see more than a short distance from the ship. The bottom was badly damaged, and it was some time before the vessel could be taken off. She was placed in dry dock by the George T. Davie Company of Levis, Quebec, and repairs made. The *Virginian* is an iron screw steamer measuring 422 feet in length, 41 in beam and 29 in depth. She has a net registered tonnage of 3,166, and 4,195 gross; was built in 1881 by the Palmers Shipbuilding Company of Jarrow, England; and is provided with a compound engine having cylinders 29 and 77 inches in diameter with a stroke of 60 inches. The ship is fitted with six bulkheads and has three decks. The photograph by Richards, of Montreal, shows her lying on the bank before being released.

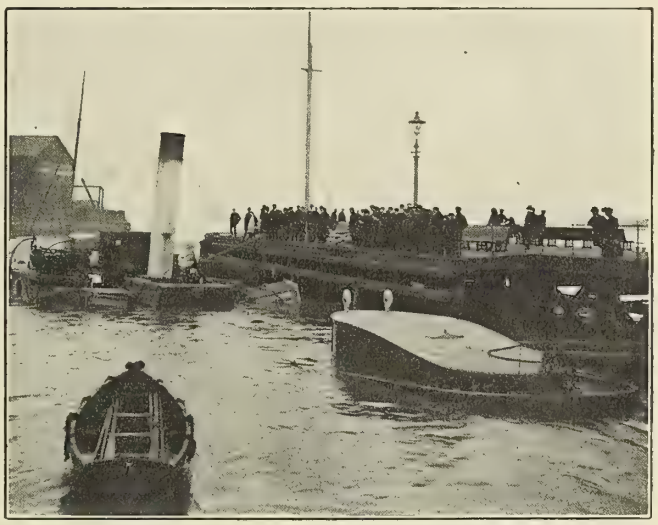
A peculiar coincidence connected with her stranding was the fact that at about the same time the new turbine steamship *Victorian* of the Allan Line went aground in the St. Lawrence, due to the same cause, and for a time it was understood in shipping circles that both of the Allan line turbine steamers

STEAMSHIP VIRGINIAN AGROUND ABOVE QUEBEC.

were aground, because of the fact that the Leyland liner happened to bear the same name as the other Allan turbine liner.

The Sinking of the Steamship Doncaster.

Due to a collision in which she was struck amidships by a large steamship, the steamer *Doncaster*, of the Great Central Railway's passenger service, operating from Hull to New Holland, England, and thereby connecting the railways of Yorkshire with those of



STEAMSHIP DONCASTER SUNK AT HER DOCK.

Lincolnshire, was so badly damaged that when the captain ran her immediately alongside the dock she went down in shallow water. Due to the fact that the cabins and all accommodations were under water for some time before the ship could be raised and repaired, it was found necessary to renew almost all the fittings, including of course all the upholstery in the accommodations, before she could again be placed in service. Fortunately no one was injured at the time of the collision.

The *Doncaster* has a length of 160 feet, a beam of 18 feet 7 inches, and a depth of 8 feet 4 inches. Her tonnage is 216 gross and 165 net.

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The edition of the April issue of Marine Engineering *comprises 6,500 copies. We have no free list, accept no return copies and issue only enough to supply the regular demand, so that the 6,500 copies represent legitimate circulation.*

The Motor Boat Show.

With the closing on the evening of March 8 of the joint Motor Boat and Sportsmen's Show in Madison Square Garden was ended what will in all probability prove to be the last joint undertaking of this sort. The growth of the motor boat business has been so great and so rapid that exhibitors this year were much crowded, while those who had only engines to show and wished to show these engines in operation were actually shoved out of the space on the main floor, which they had previously occupied, and placed in the basement. Much dissatisfaction regarding both this displacement of their exhibits and the facilities in general which were accorded resulted in the introduction of a resolution at a meeting of the National Association of Engine and Boat Manufacturers looking to a correction of this state of affairs next year.

What was finally determined upon was to hold a separate Motor Boat Show about the middle of February, the Sportsmen's Show, under separate management, coming at a later date. It was, however, determined to discontinue the use of the large tank which has been so conspicuous a feature of the show during the last few years. This tank occupied an amount of space disproportionate to the benefits which it conferred, and the decision not to use it again was the result of numerous complaints of crowding, due to its immense size. All of the exhibits next year are to be on the main floor, except for the small exhibits in the balcony; and the engines which it is desired to operate will be run by illuminating gas, as the authorities will not permit in the building the use of gasoline for that purpose.

The result of these changes ought to render the show of 1907 much superior in many ways to its predecessor, and of much more value to the designers and builders of the different appliances exhibited; for it will not only afford them immensely greater space, all on one floor, but it will also make available for their use every bit of space in the building, without the encroachment of another show of somewhat kindred nature but yet radically different, and will allow the concentration of exhibits of one sort in such a manner as to best set forth the salient features of each, both in itself and in its relation to the others.

Power Doors for Watertight Bulkheads.

In the new British battleship *Dreadnought,* which has attracted a vast amount of attention on both sides of the Atlantic, it is understood that all openings of any sort in the watertight bulkheads below the water line have been abolished. Not only this, but with no openings whatever in her armor sides, each of the watertight compartments will be absolutely self-contained, and invulnerable to any but the heaviest projectiles. This decision on the part of the British Admiralty has given rise to much speculation, for it is needless to say the arrangement of the vitals of a ship without the possibility of inter-communication from one part to another except by way of the berth deck, must needs give rise in operation to an immense amount of annoyance, and might easily lead to a great deal of confusion.

The rather remarkable tests of power doors described in another column of this issue would seem to indicate that with systems now available the method adopted by the designer of the *Dreadnought* is to a certain extent uncalled for. When a door can be closed in the face of a coal bunker and can actually cut its way down through the coal to a sufficient degree to render the opening almost absolutely waterproof, as was done in the tests in question, and when, furthermore, this door can be handled from any one of a plurality of stations situated far above any danger zone from in-rushing water, it would seem that the problem of rendering the watertight compartments of a ship watertight in fact as well as in name under all conditions of service has been so successfully achieved that little remains except to perfect a few details which might make for somewhat smoother action. These doors do not crash down through the coal, as is supposed in some quarters, but their motion is gradual and the force applied increases with the resistance until a point is reached at which an automatic cut-off releases the motor momentarily from further work. If in-rushing water should attain such volume and impetuosity as to throw any of the coal from beneath the door the automatic arrangement of the electric connections would at once re-start the motor upon the removal of the resistance due to the coal, and the door would proceed to seat itself without the

necessity of any further action on the part of any one connected with the organization of the ship.

It is obvious that when these doors are placed in any watertight bulkheads other than those leading from coal bunkers they could close immediately, without any delay occasioned by stoppage due to impediments. This being the case, the neglect to fit some such system on the great battleship above mentioned appears to us to have been in a large measure an error in design.

Delays in Warship Construction.

In another column we print a communication from a correspondent, in which he refers to the delay of more than a year in connection with beginning the construction of the two battleships authorized at the last session of congress. This delay has been not without its redeeming features, although its purpose (avowedly to obtain the permission of congress to increase the displacement of the vessels from 16,000 to 18,000 or 20,000 tons) has not borne fruit. On the original displacement, however, a design has now been prepared in which the ship carries eight 12-inch guns arranged in pairs in four turrets on two levels in such manner that the entire main battery may be trained upon one broadside. This gives a fire much superior to that shown in some of the "guesses" which have been made with regard to the disposition of the battery of the *Dreadnought,* and fully equal to that shown by the best disposition given by any of these guesses.

As a matter of fact, however, the delay is operating very adversely to the interests favoring the continued increase of the navy, not only by reason of the fact that a year has been lost which might have been put to good advantage in construction, but also because of the fact that congress has in some way obtained the idea that as we have two ships which are not yet begun, it will not be necessary to authorize any more this year, or at any future time until they shall be begun. In this way the necessary annual increase of the navy seems in danger of being passed by, with a consequent relative strengthening of the hands of our (potential) enemies.

This question of delay, not only in the department, but among the shipbuilders of the country, has long been one of extreme importance. Sometimes it is the result of circumstances over which the builders have no control, such for instance, as labor troubles, or the non-delivery of armor upon specified time; but in other cases we believe, from indications which have reached this office, the question of poor management enters very largely into the problem. There are now actually under construction for the United States Navy twelve battleships ranging from 13,000 to 16,000 tons in displacement, not counting the *Rhode Island,* which went into commission in February. Of this number not less than six are at the present time uncompleted, although the contract date of completion has past. Of these six, four were under contract to be completed in February and March of 1904—two years ago—and it is doubtful if the four will all be ready for commission before next fall. This showing is one which is not at all to the credit of the builders, although in justice to them it may be mentioned that some of the delays have been caused by alterations in design, made by the government after the ships were well under way.

So long as we continue to require five or six years after the signing of the contract before the ship is delivered to the government, just so long will we be at a serious disadvantage as compared with powers like Germany and England, which build such ships in three and two years respectively. This explains why, with nearly twice as many battleships under construction as England, our navy is increasing less rapidly than theirs.

The Merchant Marine.

From the vice-president of the Merchant Marine League of the United States:

"The recent development of the steam turbine marks an epoch in marine construction which we in this country have been slow to realize. Tests have shown that economy is secured in the turbine over the reciprocating engine from speeds not lower than fifteen knots up. At the moment this does not take in speeds below fifteen knots, or the tramp freight ship, but progress is so rapid in these days that the inventive and experimental mind is at work to secure to the turbine at the lower speeds an economy over the reciprocating type which has been in use for the past seventy-five years; in which Great Britain as the great maritime power, is equipped with some 12,000,000 tons of ships, while we have about 500,000.

"It seems to me that a new epoch for steam propulsion on the sea is at hand, and this is certainly an auspicious period for a departure in this direction. We are about to celebrate in New York City, on behalf of the whole country and for the pleasure and benefit of the whole country, a centennial of the beginning of steam navigation in the world, the initial point of which was Fulton's experiment with the steamer *Clermont* on the Hudson River in 1807.

"Is not this the time for the country to start afresh in the race in this new order of propulsion for our merchant marine and for our navy? England, on the one hand, will have to remake her ocean-going outfit, as will the other great maritime nations of the world. The United States, on the other hand, is in a position to build from the foundation up.

"The United States is like the builder who has in his possession the plans of his architects, while the money with which he is to construct his building is in the bank and the site unencumbered. Every dollar that he puts into the building will be an investment sure to return him an income, and he is in a position to so arrange the structure that it will exactly suit him.

"We are in the same position as a nation in relation to our merchant marine. I feel that this is a matter which the American people cannot longer ignore, and they certainly will not if they follow the advice of the best posted and most intelligent marine engineers."

ABSTRACT OF RULES AND REGULATIONS OF THE BOARD OF SUPERVISING INSPECTORS OF UNITED STATES STEAMBOAT INSPECTION SERVICE.

EDITION OF AUGUST 3, 1905.

ARRANGED BY HARRISON S. TAFT.

1. Bulkheads.

1. Every sea-going steamer and every steamer navigating the Great Lakes, carrying passengers for hire, shall have not less than three water-tight athwartship bulkheads, extending to the main deck in single-decked vessels, but to the deck next below the main deck in all other classes of vessels. In wooden hulls they shall be fastened to suitable framework, which framework must be securely attached to the hull and calked. In metal hulls they shall be well secured to the frame and be strengthened by angle irons spaced not more than two feet from center to center. One of the bulkheads must be placed forward and one abaft of the engine and boiler space. The third or collision bulkhead must be placed not nearer than five feet from the stem of the vessel.

2. Metal bulkheads must not be less than one-fourth inch in thickness. Wooden bulkheads must be of equal strength and be covered with plates not less than one-sixteenth inch in thickness.

3. All steam ferryboats, carrying passengers for hire, and navigating bays, sounds or rivers, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if the largest compartment is filled with water.

4. Steam vessels of one hundred tons burden or under, engaged in the coastwise bays and harbors of the United States, may carry passengers or excursions on the ocean or upon the Great Lakes for a distance not exceeding fifteen miles from the mouths of such bays or harbors, without being required to have the above three water-tight athwartship bulkheads, if in the judgment of the United States local inspectors of steam vessels such steamers shall be safe and suitable for such navigation without danger to human life, and have one water-tight collision bulkhead not less than five feet abaft the stem of said steamer.

5. A valve worked from the main deck must be fitted to all hold bulkheads.

2. Woodwork from Boilers.

1. There shall be a clear space between the boiler and the woodwork of not less than 6 inches at the sides and 4 inches at the top for external-heated boilers, but not less than 4 inches at both sides and top for internally-heated boilers.

2. All boilers shall have a clear space of 2 feet at their back and ends opposite the back-connection door. On vessels constructed of iron or steel with metal bulkheads the distance between the back-connection doors and such metal bulkheads shall not be less than 16 inches.

3. All boilers placed in wooden steamers shall have a clear space of at least 8 inches between the under side of the cylindrical shell and the floors or keelsons. On all other steamers the boilers shall be so placed as to permit of proper inspection of their under sides.

4. All woodwork or other ignitible substance approaching within 12 inches of the boiler or smokestack (unless such boiler or smokestack is covered with good non-conducting material) shall be suitably sheathed with metal over non-combustible material. All woodwork or other ignitible substance in or around the fireroom is to be properly protected by metal or asbestos sheathing.

3. Steps, Ladders, Extra Steering Apparatus.

1. Every steamer or barge carrying passengers shall be provided with suitable ladders to enable passengers to descend conveniently to the lifeboats, such ladders being placed near each side of the vessel.

2. Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with permanent stairways forward and aft, except where said stairways on towing boats would interfere with the towing bitts.

3. Extra steering apparatus, consisting of relieving tackles or tiller, must be provided for all steamers.

4. Lifeboats.

(*a*) Lifeboats on Passenger Vessels.

1. All vessels carrying passengers for hire, shall be provided with lifeboats according to the following table; except that no vessel shall be required to have more boat capacity than sufficient to carry all the passengers and crew allowed by the certificate of inspection.

2. The capacity of each and every lifeboat shall be determined by the following rule: Measure the length and breadth of each boat outside of the planking or plating, and the depth inside at the place of minimum depth. The product of these dimensions, multiplied by 0.6, resulting in the nearest whole number, shall be deemed the capacity of said respective lifeboat in cubic feet. To determine the number of passengers a lifeboat is to carry, divide the result by 10 for ocean, lake, bay and sound steamers; but by 8 for river steamers. All lifeboats must have sufficient room, free-board and stability to carry said number of passengers in safety.

3. All lifeboats shall be substantially built, the joints and seams being double riveted throughout. Only countersunk-headed rivets will be allowed in the construction of metallic lifeboats. They shall have air-tight tanks of

TABLE I.—CAPACITY OF LIFEBOATS.

Total Cubical Capacity of Lifeboats Required on Passenger Vessels Navigating Waters as Follows:

RIVER STEAMERS.	Navigating the Red River of the North and Rivers Flowing Into the Gulf of Mexico.	Navigating Rivers Flowing Into the Atlantic or Pacific Ocean and their Tributaries.
Gross Tons.	Capacity in Cubic Feet.	
Not over 10	75	75
10 " " 30	90	90
30 " " 50	120	120
50 " " 100	135	135
100 " " 150	165	165
150 " " 300	240	360
300 " " 600	360	540
600 " " 900	480	720
900 " " 1,200	600	900
Over 1,200	720	1,080

FERRYBOATS.	
Gross Tons.	Capacity in Cubic Feet.
50 not over 300	120
300 " " 600	240
Over 600	360

On ferryboats of more than 300 gross tons, one-half the boat capacity required may be substituted by its equivalent in approved life-rafts.

LAKE, SOUND, BAY STEAMERS, OCEAN-GOING VESSELS.	Navigating the Great Lakes, Sounds, and Bays.	Navigating the Oceans.
Gross Tons.	Capacity in Cubic Feet.	
Not over 10	75	75
10 " " 30	90	90
30 " " 50	120	120
50 " " 100	135	135
100 " " 150	165	165
150 " " 200	360	540
200 " " 300	540	720
300 " " 400	720	1,080
400 " " 500	900	1,260
500 " " 1,000	1,080	1,620
1,000 " " 1,500	1,260	1,800
1,500 " " 2,000	1,440	2,160
2,000 " " 2,500	1,620	2,340
2,500 " " 3,000	1,800	2,700
3,000 " " 3,500	1,980	2,880
3,500 " " 4,000	2,160	3,240
4,000 " " 4,500	2,340	3,420
4,500 " " 5,000	2,835	
5,000 " " 5,500	3,330	3,870
5,500 " " 6,000	.....	4,320
6,000 " " 6,500	.....	4,770
6,500 " " 7,000	.....	5,220
7,000 " " 7,500	.....	5,670
7,500 " " 8,000	.....	6,120
8,000 " " 8,500	.....	6,570
8,500 " " 9,000	.....	7,020
9,000 " " 9,500	.....	7,470
9,500 " " 10,000	.....	7,920
10,000 " " 10,500	.....	8,145
10,500 " " 11,000	.....	8,370
11,000 " " 11,500	.	8,595
11,500 " " 12,000	.....	8,820
12,000 " " 12,500	.....	9,045
12,500 " " 13,000	.....	9,270
13,000 " " 13,500	.....	9,495
13,500 " " 14,000	.....	9,720
14,000 " " 14 500	.....	9,945
14,500 " " 15,000	.....	10,170
15,000 " " 15,500	.....	10,395
15,500 " " 16,000	.....	10,620
16,000 " " 16,500	.....	10,845
16,500 " " 17,000	.....	11,070
17,000 " " 17,500	.....	11,295
17,500 " " 18,000	.....	11,520
18,000 " " 18,500	.....	11,745
18,500 " " 19,000	.....	11,970
19,000 " " 19,500	.....	12,195
19,500 " " 20,000	.....	12,420

Steamers above 5,500 gross tons navigating the Great Lakes, sounds and bays shall be furnished with an additional boat of not less than 495 cubic feet capacity for each additional 500 tons burden or fraction thereof.

Ocean-going vessels of over 20,000 gross tons shall be provided with an additional boat capacity of 225 cubic feet for each additional 500 gross tons, or fraction thereof.

Boats required by the above table on ocean vessels of 150 gross tons and over shall be of suitable dimensions and of not less than 180 cubic feet capacity.

1. At least one boat shall be of metal, unless exempted by the proper authorities.
2. All vessels of 50 gross tons and upward must have one working boat in addition to the boats required by the above table.
3. One-third of the boat capacity required on any vessel may be substituted by its equivalent in approved life-rafts or approved collapsible (folding) lifeboats.

I

sufficient capacity to float them when full of water and at the same time being loaded to allowed capacity. The joints of said tanks shall be both riveted and soldered. All metallic lifeboats shall be furnished with an automatic plug.

4. Metallic lifeboats of 20 feet length and under shall be constructed of metal of not less thickness than No. 18 Birmingham wire gauge. Boats 20 to 24 feet in length shall have a thickness of metal of not less than No. 16 Birmingham wire gauge for their middle half length and not less than No. 18 for their ends. Boats longer than 24 feet shall be of proportionally thicker material.

5. Each and every lifeboat shall have its cubical contents painted on the stem in black letters and figures not less than three-fourths inch high on a white ground. There must also be some plate or other device giving the number of persons each boat will carry.

6. All lifeboats on vessels carrying passengers for hire, must, if practicable, be carried under substantial davits or cranes, with two separate davits or cranes for each boat so carried, or with a single crane for each boat when such single crane is properly adapted to lower said boat. If it is not practicable to carry all the lifeboats under davits or cranes, the remainder must be stowed near at hand, so as to be easily and readily launched when required. All boats under davits must be arranged so that they can be simultaneously launched. Such davits or cranes, and the blocks and the fall thereof, on all passenger vessels except ferryboats, must be of sufficient strength to carry the boat with its full load.

(*b*) Lifeboats on Non-Passenger Vessels.

1. All vessels of less than 50 gross tons, and not carrying passengers, must be equipped with boats or rafts as in the opinion of the inspectors may be necessary to secure the safety of all persons on board in case of disaster.

2. All vessels of 50 gross tons or over not carrying passengers shall at all times be equipped with sufficient boat capacity to carry the crew of said vessel with safety.

3. Steamers of less than 150 gross tons, while engaged exclusively in harbor towing, may substitute one or more life-rafts for the lifeboats required, when the lifeboats interfere with the practical operation of said steamers, and such substitution can be made with safety. It being understood that when such vessels engage in service other than harbor towing they must be equipped with boats as required by the Rules and Regulations.

(*c*) Lifeboats for Small Steam Vessels.

1. The lifeboats referred to in table No. 1 for passenger steamers of 10 tons or under must be either carried or towed at all times when said vessels are being navigated with passengers on board.

2. All open steam launches or other steam vessels of 5 gross tons or less, used for pleasure purposes only, shall not be required to carry a lifeboat.

5. Life-Rafts.

1. The circumferential as well as the longitudinal seams of life-raft cylinders must be riveted and soldered. Only counter-sunk-headed rivets shall be used in the construction of said rafts.

2. The frame work connecting the cylinders of metallic life-rafts must be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in a surf or in a seaway.

3. Life-raft cylinders if over 15 feet in length must be constructed of metal of not less thickness than No. 18 Birmingham wire gauge. If 15 feet or less in length, metal of not less thickness than No. 20 Birmingham wire gauge is to be used. The retaining bands which secure the cylinders to the frames should be made in halves so that the cylinders may be detached without difficulty for the purpose of inspection, cleaning and painting.

4. All life-raft cylinders, except those 6 feet or less in length, must be divided by water-tight bulkheads into not less than three compartments of equal lengths, and each compartment shall be provided with a suitable air pump connection, of one-half inch diameter, fitted with an air-tight cap.

5. The inspection of a metallic cylindrical life-raft will include the testing of each compartment with an air pressure of 5 pounds to the square inch.

6. There shall be stencilled in a conspicuous place on each life-raft the number of persons said life-raft can carry, as hereinafter provided.

7. All life-rafts except the "Carley life-float" shall have an actual buoyancy of 187½ pounds upon oceans for every person allowed, and 156 pounds upon lakes, bays, sounds, and rivers for every person allowed. For the Carley life-float, the figures are respectively 145.5 and 121 pounds.

6. Life-Preservers.

1. Every vessel shall be provided with one good life-preserver for each and every person allowed to be carried on said vessel by the certificate of inspection.

2. All ferryboats shall be equipped with a life-preserver (or float where the same is allowed by law) for every 7 square feet of passenger deck surface on single-deck ferryboats and for every 12 square feet of such deck surface on ferryboats having more than one passenger deck. Said life-preservers or floats shall be distributed in the most accessible places, where they can be reached at all times.

3. All such life-preservers shall not be less than 52 inches in length when measured laid flat. Every cork life-preserver shall contain an aggregate weight of at least 6 pounds of good cork, and shall be capable of sustaining for a continuous period of twenty-four hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life-preserver of at least 20 pounds.

4. All life-rafts and life-preservers made in whole or in part of loose granulated cork shall be excluded from use on all vessels. All "kapok" life-preservers shall also be excluded from use on all vessels.

7. Line-Carrying Guns, Rockets, and Projectiles.

1. All ocean steam vessels carrying passengers, except vessels of 150 gross tons and under, shall be provided with a line-carrying projectile and the means of propelling same.

2. Where a life-gun is carried it shall be provided with at least three projectiles and the necessary lines to connect such projectiles, and at least three charges of navy cannon powder.

3. When approved rockets are used instead of guns, there shall be in every case at least three of said rockets.

4. All steamers that are required under law to carry line-carrying projectiles and the means for propelling them shall be supplied auxiliary thereto with at least 800 feet of three-inch manilla line for vessels of 100 to 500 gross tons, and 1,500 feet of said line for steamers above 500 gross tons. Such auxiliary line is to be kept always ready for use in connection with the gun or rocket, and said lines shall not be used for any other purpose.

8. Drags or Floating Anchors.

1. Drags or floating anchors shall be constructed so as to be capable of being compactly stowed near the head of the ship.

2. Steamers navigating the ocean must be provided with at least one drag, of area as follows: For steamers of 400 gross tons and under, not less than 25 superficial feet; for steamers of over 400 gross tons, the area of the drag shall not be less than that determined by adding to 25 square feet 1 square foot for each additional 25 gross tons above 400 tons.

3. Steamers of over 5,000 gross tons may be equipped with two or more drags, provided the total area is not less than that required by said rule. Steamers whose routes do not extend off anchorage are not required to have drags or floating anchors on board.

9. Steam Whistles.

1. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of said whistle below its top (when not hinged for passing under bridges).

2. Upon steamers navigating the Red River of the North and rivers whose waters flow into the Gulf of Mexico, and also steamers of less than 100 gross tons, the steam whistles shall be placed not less than two feet above the tops of the pilot houses.

3. All double-end ferry steamers, and steamers similarly constructed shall have steam whistle both fore and aft of the smoke pipe, so that the steam, when the whistle is blown, can be seen from either end of the steamer.

4. All floating structures, such as steam elevators (propelled by their own motive power) are to have their whistles located on the front side of such superstructure having an elevation higher than the pilot house of said vessels.

10. Fog Bell.

The efficient fog bell required on vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside and constructed of bronze or other material equal thereto in tone and volume of sound.

11. Fire Apparatus.

(*a*) Barrels, Buckets, Axes.

1. Fire buckets, barrels, or tanks, must, when practicable, be constantly filled with water and be in such positions on board as shall be most convenient for extinguishment of fire.

2. All axes must be located so as to be readily found in time of need. They must not be used for general purposes, and must be kept in good condition.

TABLE 2.—BARRELS, BUCKETS, AXES.

Class of Vessels.	Steamers Carrying Passengers.			Freight and Towing.		
Gross Tons.	Barrels.	Buckets.	Axes.	Barrels.	Buckets.	Axes
Not over 10	..	2	1	..	2	1
Over 10 " " 25	..	4	1	..	4	1
" 25 " " 50	1	6	2	1	6	2
" 50 " " 100	1	8	2	1	8	2
" 100 " " 200	2	18	4	1	12	2
" 200 " " 500	4	24	6	2	15	3
" 500 " " 1 000	6	35	8	3	20	4
" 1,000	8	50	10	4	25	5

Tanks of suitable dimensions and arrangements, or buckets of sufficient number, may be substituted for barrels on all vessels. Five buckets shall be considered as equivalent to one barrel.

(*b*) Steam Pipes to Holds.

1. The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same, except the cabins, shall not be less than 1½ inches in diameter.

2. Steam pipes of not less than ¾-inch in diameter must be led to all lamp lockers, oil rooms, and like compartments. Said lamp lockers, oil rooms and compartments being wholly and tightly lined with metal.

(*c*) Fire Pumps.

1. Steamers required to be provided with double acting steam fire pumps, or equivalents for throwing water, shall be equipped with such pumps, according to their tonnage, as follows: Steamers under 3,000 tons shall have not less than one-third of one cubic inch pump cylinder capacity for every gross ton. Steamers over 3,000 tons shall have pump cylinders of not less than 1,000 cubic inch capacity.

2. Upon such steamers fire mains shall be led from the pumps to all decks, with a sufficient number of outlets, arranged so that any part of the steamer can be reached with water with the full capacity of the pumps and by means of a single 50 foot length of hose from at least one of said outlets. Every such pump shall be fitted with a gauge and a relief valve adjusted to lift at 100 pounds pressure.

(*d*) Fire Hose.

1. Fire hose shall in no instance be less than 1½ inches in internal diameter.

2. Steamers of 15 tons and under may use hose of ¾-inch internal diameter, but in no case shall it be less than the discharge opening of the pumps. Open boats of less than 10 gross tons that are fully equipped with buckets shall not be required to carry hose.

3. At least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle.

(*e*) Fire Extinguishers.

Fire extinguishers must be located so as to be most convenient and serviceable in case of need.

TABLE 3.—FIRE EXTINGUISHERS ON STEAMERS CARRYING PASSENGERS.

Gross tons	Under 50	50 to 100	100 to 500	500 to 1,000	Over 1,000
Number of extinguishers	1	2	3	6	Not less than 8

(*f*) Ferryboats.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage.

12. Steamer's Name on Equipments.

All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life-preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used.

13. Equipment for Barges.

1. Barges carrying passengers on any routes shall have a life-preserver or float for each and every person allowed to be carried, and in addition thereto shall be supplied with 10 buckets, 2 barrels of not less than 40 gallons each, 3 axes, 1 hand fire pump, capable of discharging 100 cubic inches of water at each stroke, and sufficient length of regulation hose to reach to all parts of the vessel. Also two yawl boats of not less than 120 feet capacity each.

2. All barges in tow of steamers used for transferring persons on any lake, bay, sound or river shall be provided with the same life-saving appliances as required for passenger steamers.

3. All barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high.

4. Every barge carrying passengers in tow and engaged in excursions, shall be supplied with one life-preserver or one float for each person carried, and must have ten buckets, three axes, and two yawl boats of not less than 100 cubic feet capacity each, one of which boats must be manned and towed in such a manner as to best afford prompt relief and assistance in case of accident or disaster.

14. Sail-Vessel Equipment.

Sail vessels of over 100 gross tons carrying passengers on the ocean or on the high seas are to be equipped with a life-preserver for every person on board, passengers and crew, and with lifeboats in accordance with the requirements of the rule applying to ocean steamers carrying passengers.

15. Ferryboat Equipment.

1. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life-rafts, outside ladders, and other means of escape, in case of disaster, as in the opinion of the inspectors, shall meet the requirements of each particular case.

2. In no case shall the cubic feet of boat capacity be less than that provided in Table No. 1.

16. Car Ferries.

All steamers, or barges in tow of steamers, used for transferring railroad passenger cars on any lake, bay, sound or river, with passengers in cars, shall be required to have the same life-saving appliances as required on passenger steamers.

17. Excursion Steamers and Barges.

1. Passenger steamers making excursions on the Great Lakes, bays or rivers, or on waters of the Atlantic and Pacific coasts and rivers flowing into the same, and rivers whose waters flow into the Gulf of Mexico, shall have, in addition to their regular life-saving equipments, a life-preserver (or float where the same is allowed by law), or their equivalent in other approved life-saving appliances, for each additional passenger allowed, over said vessels' ordinary allowance.

2. Steamers making excursions under a special permit must have at least one lifeboat or life-raft, in addition to their regular required equipment, so carried as to best secure the safety of those on board in case of disaster.

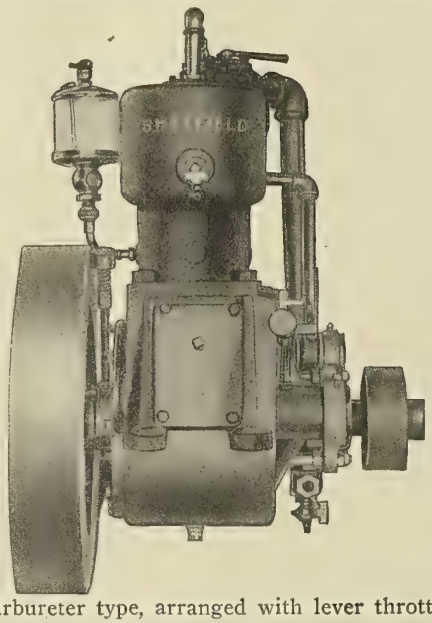
18. Legal Draft.

The owner, agent or master of every inspected sea-going vessel shall indicate the draft of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit, as indicated, shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate.

ENGINEERING SPECIALTIES.

Sheffield Single Cylinder Four-Cycle Marine Engine.

Realizing the constant increasing demand and the usefulness of a practical and inexpensive power for small boats, yachts, luggers, etc., Fairbanks, Morse and Company, Chicago, have brought out a four-cycle engine of the simplest possible construction, with as little weight as is possible in modern engine practice. The type is vertical, with an inclosed crank case made with movable bearing plates, in which are mounted movable liners. The base is provided with hand hole plates, affording easy access for adjusting and inspection. The crank case being closed and oil tight, the engine is operated on splash lubrication. An entirely different method, however, is used from that ordinarily followed, as there is arranged inside of the base an oil separator, removing any heavy or foreign properties from the oil, and preventing them from re-entering the bearings.



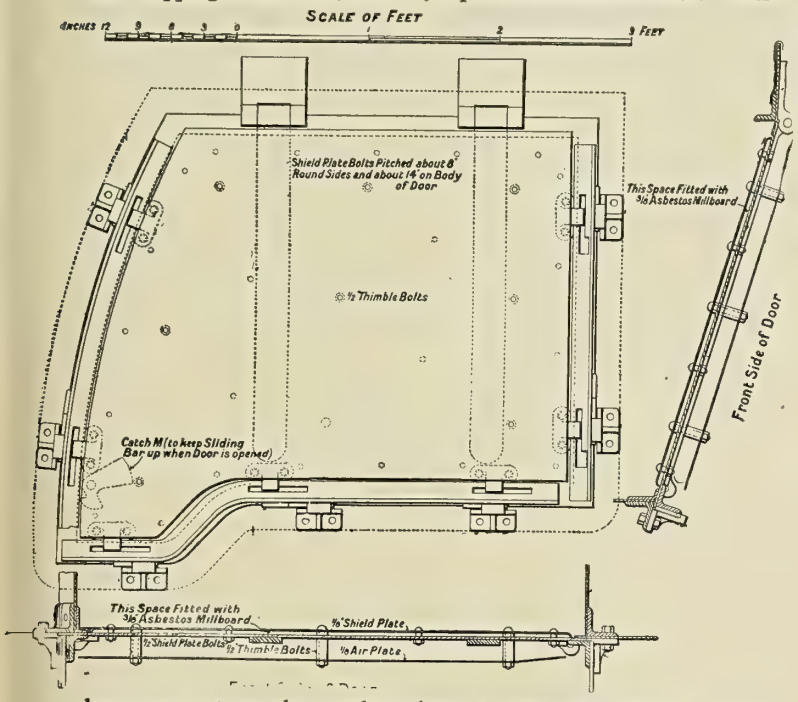
The cylinder and head are cast in one piece, and water-jacketed. The valve chambers and valves are also water-jacketed. All valves are readily removed by loosening a bolt and swinging off the cover. The ignition is of the jump spark type. Commutator is independent, removable and renewable, arranged to be shifted to vary the time of ignition. The mixer is of the float feed carbureter type, arranged with lever throttle for varying the quantity of mixture admitted to the engine. The regulation is such that the engine has a wide range of speed.

A small circulating pump is attached to the engine for

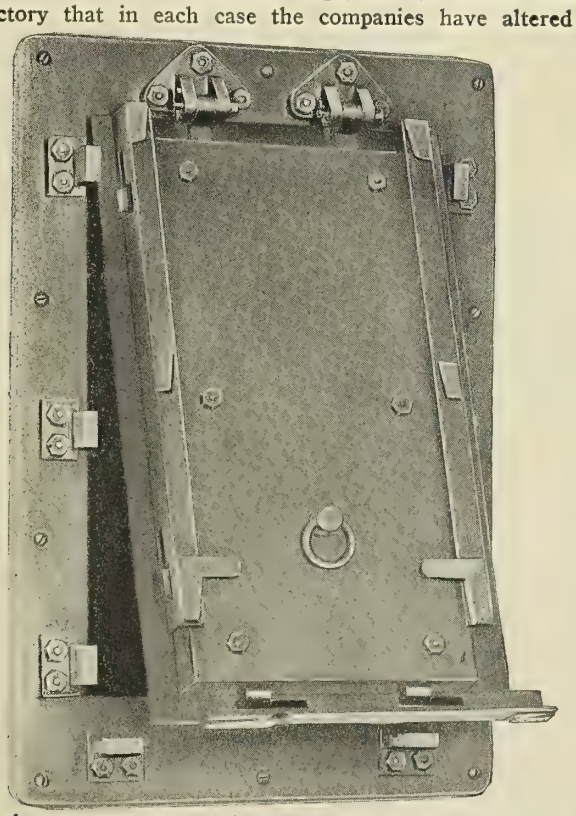
assisting circulation of the cooling water through the engine jacket. The gearing is cut and runs in an oil bath, thus making it quiet and reducing wear to a minimum. The crank shaft is of nickel steel. Connecting rod is drop forged. The size of engine now ready for the market is 4½ H. P.

Silley's Patent Smoke Box Door.

One of the most successful marine patents introduced during the past year, and which was awarded a gold medal at the Naval and Shipping Exhibition, is Silley's patent smoke box door. This


Scale of Feet
Shield Plate Bolts Pitched about 8" Round Sides and about 14" on Body of Door
This Space Fitted with 3/16 Asbestos Millboard
½ Thimble Bolts
Front Side of Door
Catch M (to keep Sliding Bar up when Door is opened)
This Space Fitted with 3/16 Asbestos Millboard
⅜ Shield Plate
½ Shield Plate Bolts
½ Thimble Bolts
⅛ Air Plate

door was put on the market about a year ago, after a severe trial in four different companies' ships, and the results were so satisfactory that in each case the companies have altered the



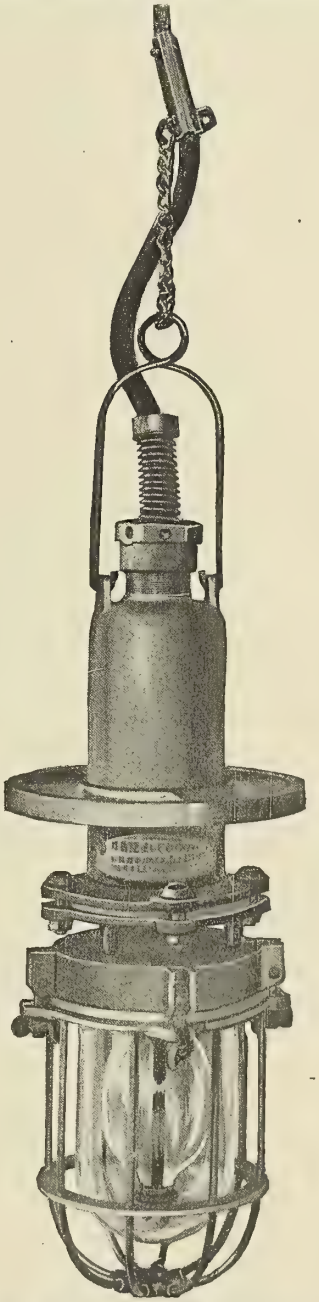
whole of the existing doors in these ships; within the last four months something like 1,200 of these doors have been ordered and specified.

It is stated that in cases where old fittings have been taken off and these doors substituted, greater efficiency has been obtained. Other advantages are: the reduction of speed on the fan engine of twenty percent, due to the smoke box doors being air-tight; the total absence of flaming at the funnel caused by gases in the smoke box door, the incoming air causing reignition of the gases in the route of the funnel, often with disastrous results; and no continual removals of catches.

Not only are these doors being adopted quite universally in England, but also in America, while arrangements have just been completed for their manufacture and fitting in Germany, France, Italy, Japan and other countries. The owners of this invention are the Air-Tight Smoke Box Door Syndicate. Mr. W. Carlile Wallace, Box 161, Tenafly, N. J., is the American representative.

Yale Submarine Electric Search-Light.

Owing chiefly to the fact that comparatively few intelligent persons have ever ventured to don diving armor and descend be-



low the surface, an air of mystery has come to enshroud the work of a submarine diver. In the shadow of a ship's hull, or an obstruction, or at depths of 50 feet and over, there exists an impenetrable gloom even with fairly clear water; while in the usual

dirty harbor the sun's rays never reach the bottom. In order to render the services of a diver of real value in making durable repairs it has been found necessary to considerably change the methods of operation and equipment. The question of light, the first step, is claimed to have been solved by the use of the powerful Yale submarine electric lamp, placed upon the market by the Chicago Pneumatic Tool Company. The complete equipment is designed to be placed aboard a ship in its own chest ready for use. The light from this lamp illuminates brightly a space the size of a large room. The lamp consists of a watertight metallic case inclosing a mechanism and regulator arranged so that when the lamp is submerged it will give forth from the glass chamber at its lower end a most brilliant clear light, better than the average street arc lamp. When in use the diver may carry the lamp about by means of the circular guard-handle, set it down, or suspend it in a convenient manner directly by the cable, no ropes being required. Its weight under water is only a few pounds, just enough to keep in position in a current or tideway. The cable conducting the current to the lamp leads to the surface and thence to a combined junction and switch plate controlled by the diver's attendant. From this plate, connection is made to a neighboring electric circuit, storage battery, or small generator outfit supplying the electric power. Compact, of few parts, and simple in operation, these submarine outfits afford means for use aboard ship, about a dockyard, mine, water-works, engineering construction, wherever a perfect light is desired for use under water or in a gaseous atmosphere.

TECHNICAL PUBLICATIONS.

Marine Engineering. The calculations, designing and construction of the modern marine steam engine, including marine steam turbines. A manual of the most recent practice for the use of engineers. By Hermann Wilda. Size 17½ by 24 inches. Plates, sixty-four, covering about 1200 illustrations. Hannover, 1904. Gebrüder Jänecke. Price $14.00.

This remarkable collection of drawings covering every phase of the construction of marine engines and accessories gives a very wide range of practice from English, German and American yards, and in very considerable detail. Nearly every engine illustrated is shown in both general arrangement and in much detail, and in every case with complete dimensions, the latter being entirely in millimeters. The notes accompanying the illustrations are printed in both English and German, and the plates, even without text, form a very valuable contribution as a ready means of reference to the best modern design.

Illustrating the scope of the work, it might be mentioned that machinery is illustrated from, among others, the following ships: *Spokane;* Holland-American, *Potsdam;* Hamburg-American, *Dortmund;* United States battleship, *Ohio;* the steamships *Sylvia, Asturia, Alaskan, Friedrich der Grosse, Neckar,* and *Victoria Luise.* As illustrating the completeness of presentation in these several cases it might be interesting to note the amount of detail in a single case,—that of the United States battleship *Ohio.* The plates for this ship cover eight of the sixty-four, and include the following: Longitudinal elevation and section of main engine; end view of same; sections and stud diagram of cylinder liners and covers; cross section of cylinder lay-out; longitudinal section of high pressure cylinder and valve chest with details, as well as the detail lay-outs of the other cylinders; high-pressure piston valve section, with a number of details of parts; the same amount of detail for the intermediate and low pressure cylinders, together with plans of cylinder covers and valve chests; sections and elevations of the slide valves for intermediate and low pressure cylinders; connecting rod drawings, including details and oiling system; piston rods; crossheads with details; crankshaft bearings; cylinder stuffing boxes; engine frame in much detail, and main bearings; three views of condenser, including section, besides a number of details; bilge and sanitary pumps in considerable detail. Some of the other cases include screw propellers, eccentrics, reversing and turning engines, and circulating pumps; and the examples are picked out so as purposely to include practice in compound, triple and quadruple expansion engines. In some cases independent machinery lay-outs are included, showing the relation of each part with regard to all the others, and giving not only cross sections of the ship, but longitudinal sections and plans of the engine room.

The importance of the work is very great and it should prove exceedingly valuable to designers of all sorts of marine machinery.

Steam Turbines. By Carl C. Thomas, Professor of Marine Engineering, Sibley College, Cornell University. Size 5¾ by 9 inches. Pages, 286. Figures, 92; plates, 17. New York, 1906. John Wiley & Son. Price $3.50.

The development of the steam turbine has been so rapid that many of the problems involved, while solved more or less satisfactorily for constructive purposes, have not been put upon a scientific basis. The velocity of steam flow under given conditions, which is important both for an understanding of the operation of the turbine and for predicting results to be obtained in any design, is one of the most important of these problems. The present work has consisted largely in an analysis and correlation of the results of important experimental investigations along this line, as well as on other points, and an attempt to use these results in connection with well known laws of hydraulics and thermodynamics, in the development of the theory and practice of the steam turbine. The book is expressly stated not to be a treatise on either hydraulics or thermodynamics, merely an outline of each being given in sufficient detail to use as a working basis.

The general subjects taken up under chapter headings include the action of steam upon turbine buckets; thermodynamics involved in the flow of steam; graphical representation of work done in heat transformations; calculation of the velocity and weight of flow; frictional resistances as affecting velocity; experimental work on the flow of steam through orifices, nozzles and turbine buckets. After this the turbine proper is discussed under headings of impulse turbines and impulse and reaction turbines; while another chapter is devoted to a description of the four turbines most prominent in practice in the United States—Westinghouse-Parsons, Curtis, Allis-Chalmers and De Laval. The last chapter is the one of most interest to our readers, as it deals with the marine steam turbine, and a considerable amount of data is given, thoroughly up to date, including particulars of installations as recent as those of 1905 in the *Carmania,* and other ships of that date. Illustrations in this section include three cuts showing the installation of the turbines on the *Carmania,* and three others giving curves of economy obtained on tests of various cruisers and torpedo-boat destroyers, as compared with similar vessels fitted with reciprocating engines.

Throughout the work the results of tests are given much prominence, and are, of course, invaluable, as showing what has been accomplished, and giving some means of predicting what may be obtained in future constructions. Illustrations are well chosen and well engraved, and the book as a whole forms a notable addition to the literature on this very lively topic.

Notes of Heating and Ventilation. By John R. Allen, A. S. M. E., Junior Professor of Mechanical Engineering, University of Michigan. Size 4½ by 6½ inches. Pages, 152; illustrations, 34; tables, 35. Chicago, 1905. Domestic Engineering. Price $2.00

This book is largely made up from the lectures delivered by the author to his classes on the subject, in the University of Michigan. It was written primarily for the steam fitter and the designer of heating systems, and presupposes a knowledge of the construction and operation of the simpler forms of such systems. It realizes at the outset that heating and ventilation have not yet become an exact science, but are dependent very largely upon questions to be settled by judgment and experience.

The introduction to the book takes up the general theory of heat and specific heat, and the work opens with a discussion of the loss of heat from buildings by transmission through walls and windows, by convection currents and by passage of air through the walls. The tables include the radiating and conducting power of various bodies; relative heat loss of different sorts of material, and the heating properties of same; sizes of flues for indirect radiation; computations for a specific case of a house of medium size for both direct and indirect systems of radiation; sizes of pipe and mains for heating; heat losses in ventilation, again taking up the specific case; capacities of fans under varying revolutions and other conditions; losses of pressure in pipes; relative values of different pipe coverings; and a number of other subjects connected with the general title. The different forms of heating are described and examples given, showing the processes by which the design of systems is brought about for both direct and indirect steam heating. The subject of ventilation is given very careful consideration in the last half of the work, and in both parts the illustrations are practical and well suited to the purpose in hand.

Link Motions, Valves and Valve Setting. By Fred H. Colvin. Size 4 by 6 inches. Pages 82; figures, 43 and one folding plate. New York, 1905. The Derry-Collard Co. Price 50 cents.

This little work covers the general subjects of locomotive link motion, valve movements, methods of setting the slide valve; analysis by diagrams of the slide valve and its operating mechanism; modern practice in length and angularity of eccentric rods, leads, lap, proportions of travel, piston speed, etc.; block slip; various forms of slide and piston valves, methods of setting piston valves and a short description of other forms of valve gears. The work appears to be thoroughly practical and the illustrations in particular are carried out with much care and are very clear. They are largely of the diagrammatic form so necessary to easy comprehension and clearness in design. Rules are given for determining variation of lead under various conditions, and examples are quoted giving the proportions in general of American valve motions for locomotives of different piston speeds and cylinder dimensions.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

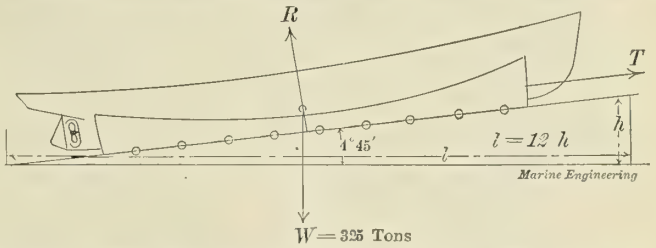
Q. 332.—Will you give a rule to find the number of tons of dead weight a boat will carry. The boat in question is built on the scow model. Her dimensions are as follows: length on deck, 125 feet; length on bottom, 100 feet; beam amidships on deck, 23 feet 9 inches; beam, forward 20 feet; beam, aft 21 feet; beam, amidships on bottom 22 feet 9 inches; beam, forward 19 feet; beam aft, 20 feet; depth of hold amidships from underside of deck to top of keelson, 5 feet; depth over all from top of deck to bottom, 6 feet 6 inches. J. E. B.

A.—There is no definite rule by which the dead weight carrying capacity of such a boat can be determined until we know the weight of the boat empty. In that case the capacity would be the difference between the displacement of the craft at the deepest draft to which it could be safely loaded, and the weight of the hull.

If the result were required from the point of view of knowing the draft of the boat light and the draft to which it was proposed to load it, the problem would be a very simple one. In this case, we would multiply the area of the load water plane by the difference in the drafts in feet, and dividing the result by 35 would obtain the dead weight carrying capacity in tons. The load water plane of such a vessel would be about equivalent to the product of the mean length of the vessel by the mean beam. In this case the mean length is 112½ feet, the mean beam about 21 feet, and the amount of dead weight carrying capacity for each foot of additional draft figures out as about 67.5 gross tons.

Q. 336—I am getting out a small marine railway and as I do not have much depth of water I am making it of a special design. I would like to know the method of estimating for the power required to haul this out, also the size of wire rope or chain necessary. If possible, please give me the coefficient of friction on rollers, and method of working it out to find force required to haul same out. Weight of vessel, 300 tons; weight of ways, 25 tons; inclination of ways, 1 in 12; to haul out in about one-half hour. J. R.

A.—The resolution of forces, as indicated in the accompanying diagram, shows a downward force due to the action of gravity of 325 tons, a force directed generally upward, due to the reaction of the rail upon the rollers and ways, of an amount to be determined later, a force acting longitudinally of the ways, and representing the tension in the cable used for drawing the ship out of



the water. This also will be determined later. The angle of inclination of the rails is such that the tangent is one-twelfth, which makes the angle 4° 45′. It results from this that the force acting upwards from the rollers is 325 sin 85° 15′ = 324 tons. The force longitudinally of the ways is 325 sin 4° 45′ = 26.9 tons.

The coefficient of friction in a case like this is not thoroughly well known, but may be assumed to be about equivalent to that given by rather poor results of railroad car wheels and axles. This would place it at about three percent, and would make the total friction of the rollers upon the rails 9.7 tons. This makes the force to be applied through the wire ropes used for hauling the ship out of the water 26.9 + 9.7 or 36.6 tons. It follows that a total force of about 37 tons will be required to give the ship a slow motion up the ways. It should be noted that this is a maximum, and a figure which is attained only after the ship is entirely out of the water. Before the ship leaves the water, the force required would be very much less, because much of the weight of the ship will be supported by the buoyancy of the water.

If we assume that a wire rope one inch in diameter is to be used, we find that the ultimate strength of such a rope is about 50,000 pounds. The use of six such ropes would so distribute the stress as to allow for a factor of safety of about 3.5, while eight ropes would increase this factor of safety to about 5, which ought to be ample. These ropes might be attached readily at two points, by using sheaves of considerable diameter (say 30 inches), and taking advantage of the fact that these sheaves might be so adjusted as to operate as pulleys, with four ropes at each point of attachment.

The time required to haul up the vessel is not directly dependent upon the force to be overcome, but is rather dependent upon the power utilized for the purpose. If the total distance through which the average resistance has to be met is 300 feet, and it is required to perform the operation in one-half hour, the average speed will be 10 feet per minute. This would require the application of about 25 horsepower to the ways, which would mean an engine of about 35 indicated horsepower, the difference being absorbed in engine friction and friction in the sheaves.

Personal.

Geo. H. Waring, Jr., late chief engineer in the steamship service of the Standard Oil Company, has joined the staff of the Union Foundry & Machine Works, Limited, St. John, New Brunswick, as outside manager.

In accordance with an act of congress, approved February 27, making the office of Engineer-in-Chief of the Revenue Cutter

Service a presidential appointment, the President on March 1 nominated the present incumbent, Chief Engineer Charles A. McAllister, for the post.

Obituary.

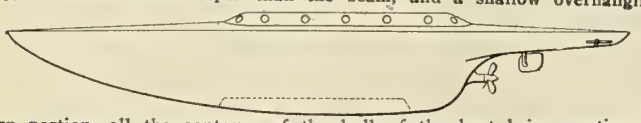
Frederick T. Towne, general superintendent of the Yale & Towne Manufacturing Company of Stamford, Conn., died suddenly on February 4 at the opening of a very brilliant business career. He was a graduate of the Massachusetts Institute of Technology, was in his thirty-fourth year, and was a son of the president of the company.

George V. Sloat, who resigned as superintending engineer of the Old Dominion Steamship Company six years ago, died February 14 at the age of seventy-nine. For a period of fifty years Mr. Sloat was identified with marine matters in various parts of the United States, the last thirty-five years having been in the service of the Old Dominion Company.

SELECTED MARINE PATENTS.

806,223. SUBMERGIBLE SURFACE BOAT. THOMAS H. WHELESS, NEW YORK, N. Y.

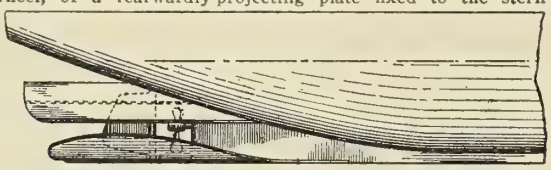
Claim.—4. A marine vessel adapted to run along the surface of the water or to be submerged when desired, comprising a sharp and narrow fore body, a narrow waist deeper than the beam, and a shallow overhanging



stern portion, all the contours of the hull of the boat being continuous curves, the lower portion of said waist being weighted, and the maximum width of each cross-section being at the deck-line, with a deck tapering slightly downward toward the bow and stern, and an elongated conning-tower mounted in the deck above the waist portion. Thirteen claims.

806,484. HULL OF VESSELS. ISAAC E. PALMER, MIDDLETOWN, CONN.

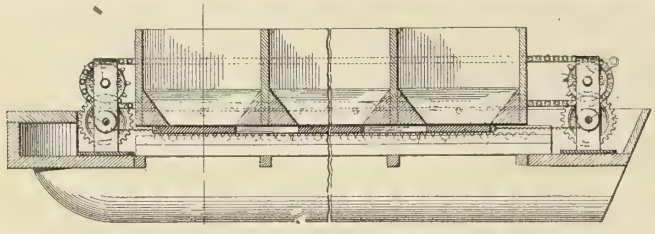
Claim.—3. The combination with the hull of a vessel provided with a power-wheel, of a rearwardly-projecting plate fixed to the stern portion



thereof and extending rearwardly above the wheel and laterally projecting wings on the keel below the said wheel arranged to co-act with the plate above the wheel to hold the water to the wheel. Four claims.

807,552. DUMPING-SCOW. JOHN GUIRY, NEW YORK, N. Y.

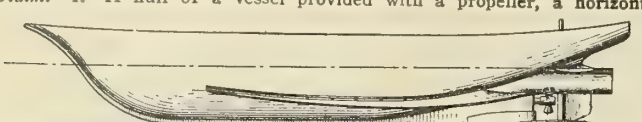
Abstract. The invention comprises two suitably-separated pontoons connected together by a deck, a longitudinal series of bins or hoppers arranged upon the scow and disposed between the vertical planes of the facing sides of said pontoons, a horizontally and longitudinally sliding gate for the bottoms of said bins or hoppers, and means for operating said gate, said bins or hoppers at their front and rear inner lower portions having



inclined or converging walls and said gate having a series of openings adapted at the proper time to register with the lower ends of said bins or hoppers, so as to permit the discharge of the refuse downwardly between said pontoons. The aforesaid sliding gate will when in one position close the lower ends of the bins or hoppers, so that the latter may be filled, and when moved from such position said gate will carry its discharge-openings below said bins or hoppers, and at such time the refuse may at once escape downwardly. Five claims.

807,769. HULL OF VESSELS. ISAAC E. PALMER, MIDDLETOWN, CONN.

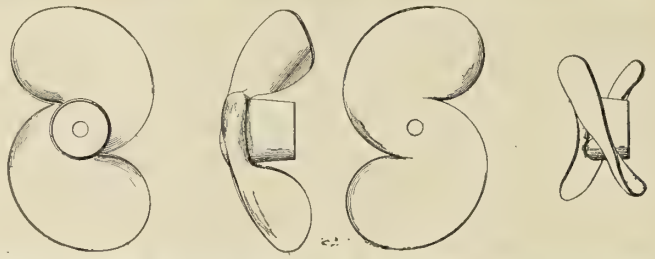
Claim.—1. A hull of a vessel provided with a propeller, a horizontal



wall extending rearwardly over the propeller, and bilge-keels merging into the opposite edges of said horizontal wall. Four claims.

807,974. PROPELLER. EDWARD A. STICKLER, PORTAGE, WIS.

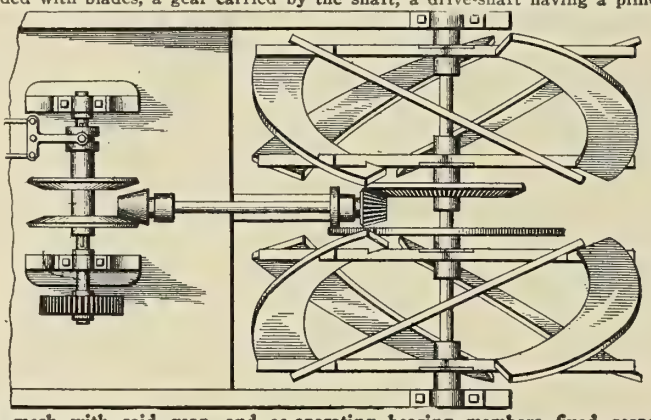
Claim.—1. A propeller having a hub and spiral cam-shaped blades, the front sides of which project from the front portion of the hub, said blades being curved rearwardly over the rear portion of the hub, widened progressively from the hub rearwardly and terminating in rearwardly-projecting wings, the rear edges of which present convex curves that extend from the outer edges of the blades inwardly, and the inner edges of which are spaced



from the sides of the hub and merge in the front portions of the blades attached to the hub. One claim.

808,034. PROPELLER. JOHN C. FRANKLIN, GALLATIN, TENN.

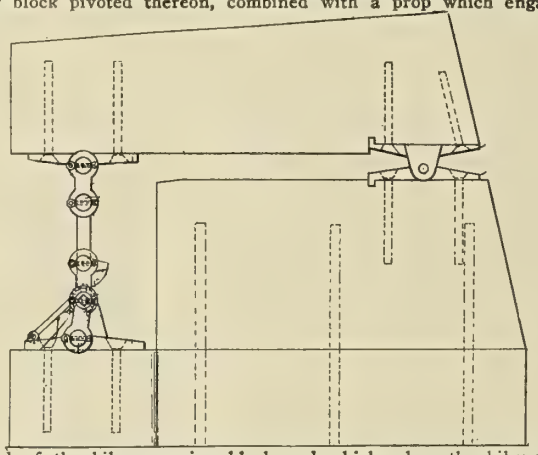
Claim.—1. In a device of the class described, a propeller-shaft provided with blades, a gear carried by the shaft, a drive-shaft having a pinion



in mesh with said gear, and co-operating bearing members fixed respectively on said shafts and acting to maintain the gear positively in mesh with pinion. Three claims.

808,072. BILGE-BLOCK FOR DRY-DOCKS. JAMES L. CRANDALL, MALDEN, MASS., ASSIGNOR TO H. I. CRANDALL & SON CO., BOSTON, MASS.

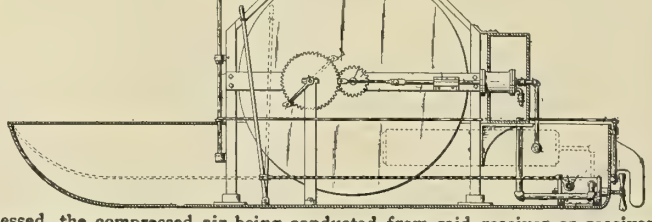
Abstract.—The invention consists, essentially, in a base-block and a bilge-engaging block pivoted thereon, combined with a prop which engages the



outer end of the bilge-engaging block and which when the bilge-engaging block is in its uppermost or normal position occupies a perpendicular position, but which is adapted to be moved downward and into an inclined position to drop the outer end of the bilge-engaging block, and means for moving said prop. Twenty-four claims.

808,346. BOAT-PROPELLING MECHANISM. PATRICK E. CROWE, NEWARK, N. J.

Abstract. This invention relates to a novel means of propulsion for boats, comprising an air-engine driven from compressed air, an arrangement of air receiver or receivers into which the air is to be delivered and com-



pressed, the compressed air being conducted from said receiver or receivers, preferably two of them, to the air-engine, which is provided with a pair of turbines or wheels running independently of each other in opposite directions, for the forward or backward propulsion of the boat, as may be desired, an independently-arranged and independently-acting and preferably manually-actuated pump-operating mechanism and pump or pumps for forcing air into said receiver or receivers. Seventeen claims.